ASM REVIEW OF METAL LITERATURE

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REVIEW OF METAL LITERATURE

An Annotated Survey of Articles and Technical Papers Appearing in the Engineering, Scientific and Industrial Journals and Books, Here and Abroad.

Volume 3

1946

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PREFACE

The A.S.M. Review of Current Metal Literature is a monthly feature of *Metals Review,* published by the American Society for Metals and distributed to its members. The present volume is a collection of the installments published in *Metals Review* from February 1946 through January 1947, and represents a complete survey of the metallurgical literature published during the period January through December 1946. It is a sequel to the first two volumes which covered the years 1944 and 1945.

The annotations are not intended to serve as a substitute for a reading of the articles listed. They are brief abstracts designed to indicate the scope and content of the article so that you may determine whether it is something you want to read in its entirety.

Attention is called to the table of contents immediately following and to the subject index starting on page 770. The table of contents lists the various subdivisions and classifications with explanatory notes on each; this classification is arranged primarily by processes. The subject index supplants and greatly amplifies the "Materials Index" published in the monthly issues of *Metals Review.* While the emphasis here is placed on materials, processes are likewise indexed in detail in this section of the book. Subheads and cross-references are included in sufficient detail to permit the location of articles on any specific subject related to the metal industry. Indexing is based on the content of the article and not merely on the title.

In using the book, if the primary interest is in the broad field of corrosion, or foundry practice, or welding, turn immediately to the respective section as given in the

table of contents. If the main interest is in aluminum alloys, or copper, or cast iron, turn to the corresponding heading in the subject index. If interest lies in specific aspects of corrosion, or a particular type of welding, these broad processes will be found broken down and subdivided in the subject index. An author index is also provided and a list of addresses of the publications annotated.

Every effort has been made to render the Review of Metal Literature complete. The cooperation of the library staff of Battelle Memorial Institute with the editors of *Metals Review* in attempting to make the annotations accurate, complete, and useful is gratefully acknowledged.

AMERICAN SOCIETY FOR METALS

May 1, 1947

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SECTION I

ORES & RAW MATERIALS

Production; Mining; Beneficiation

1-1. Barium and Its Alloys. W. J. Kroll. *Metal Industry,* v. 67, Dec. 14, '45, pp. 398-401.

Examines possibilities of certain processes for making barium and its alloys. Confined to the reduction of barium oxide with aluminum or silicon. (From the Bureau of Mines Information Circular 7327.)

1-2. Ore Testing. H. L. Saunders and H. J. Tress. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 565-567.

The "S.K." porosity test. Theory of the method; apparatus; experimental procedure; porosity results; tests on ores; tests on sinters.

1-3. Sinters and Sintering. H. L. Saunders and H. J. Tress. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 567-572.

Effect of temperature and preparation on reducibility and strength.

1-4. Concurrent Firing at the Sulphur Bank and Reed Quicksilver Plants. R. G. Hall and Worthen Bradley. *Metals Technology,* v. 12, Dec. '45, T. P. 1889, 12 pp.

Ores contain sufficient sulphur, in various forms, to render difficult the condensation of free mercury. Sulphur does not completely oxidize in ordinary countercurrent firing, but recombines with mercury in condensers and comes down in the soot. Laboratory rotary kiln fired concurrently at 1200° F. indicated that this practice would burn out all the sulphur and allow condensation of free mercury. 15 ref.

1-5. Equilibrium in the Reduction of Ferrous Chromite by Hydrogen and Energy Requirements in the Selective Reduction of Iron in Chromite. F. S. Boericke and W. M. Bangert. Bureau of Mines Report of Investigations 3813.

Preparation of substantially pure ferrous chromite, the apparatus and method for studying equilibria in the selective hydrogen reduction reaction, the derivation of the heat and free energy of formation of ferrous chromite from the equilibrium data, and some application of the thermodynamic values to the selective reduction of chromite by other reducing agents, particularly solid carbon and methane.

1-6. **Effect of Variables in Chemical Beneficiation of Chromite Ores.** F. S. Boericke and W. M. Bangert. Bureau of Mines Report of Investigations, 3817.

Laboratory techniques employed in more than 100 small-scale experiments to test certain phases of the selective reducing and leaching process for the enrichment of low grade domestic chromite ores.

1-7. **Iron Ore Review for 1945.** M. D. Harbaugh. *Blast Furnace and Steel Plant,* v. 34, Jan. '46, p. 69-76.

Lake Superior ore; end and aftermath of the war; scrap in relation to ore; labor supply; Lake Superior ranges; Canadian districts; other districts in the United States; foreign sources.

1-8. **Late Developments in the Beneficiation of Lake Superior Iron Ores.** Grover J. Holt. *Blast Furnace and Steel Plant,* v. 34, Jan. '46, p. 77-84.

Research by iron ore producers; log washers; sink-float process; new machine; sintering.

1-9. **System for Preparing Ore at the Minnequa Works of the Colorado Fuel and Iron Corp.** R. R. Williams. *Blast Furnace and Steel Plant,* v. 34, Jan. '46, p. 108-114.

Crushing and screening; sintering plant operation; blending and reclaiming; sampling and weighing; analyses; general notes on the operation of the plant.

1-10. **Production of Beryllium Oxide.** H. Lundin. *Transactions of American Institute of Chemical Engineers,* v. 41, Dec. 25, '45, p. 671-691.

First step in the manufacture of any beryllium containing product is the isolation of the beryllium oxide from the ore. Only a small quantity of the oxide is used in the manufacture of fluorescent lamps and refractories. The main quantity is used in the production of beryllium alloys and especially beryllium-copper. Fluoride process (Copaux process); sulphate process; sodium bicarbonate process; ammonium carbonate process; alkali processes; acid processes; fluoride processes; sulphide processes. 58 ref.

1-11. **Concentration of Oxide Manganese Ores From Clallam County, Wash.** T. F. Mitchell and Walter J. Long. *Bureau of Mines Report of Investigations* 3837, Dec. '45, 7 p.

Results of laboratory and pilot-plant investigations. Owing to the complex nature of the ores, no effective concentration by ore-dressing methods was possible. No high grade manganese concentrates were produced and the highest recovery at minimum acceptable grade was only 53% on one of the ores tested.

1-12. **Performance of a Hydraulic Classifier Designed to Incorporate Four Hitherto Neglected Principles.** Will H. Coghill, G. D. Coe and I. L. Feld. *Bureau of Mines Report of Investigations* 3844, Dec. '45, 13 p.

Details of design, results of preliminary research and final testing.

1-13. **German Magnesium Production.** *Chemical Age,* v. 54, Jan. 5, '46, p. 15-17.

Magnesium production from carnallite and high magnesium content dolomite discussed. Includes remarks concerning slaking, briquetting, drying and chlorinating of

raw material and a discussion of the electrolysis technique employed.

1-14. **Potential Sources of Aluminum in Southwestern China.** Chingyuan Y. Li and C. Y. Hsieh. *Mining Technology,* v. 10, Jan. '46, T. P. 1938, 6 p.

Possible sources appear to be alunite, the alumina-rich shales, and the bauxite deposits; locations of deposits are shown.

1-15. **Beneficiation of Blast Furnace Coke at the Kaiser Steel Co., Fontana, Calif.** J. Howard Thompson. *Blast Furnace and Steel Plant,* v. 34, Feb. '46, p. 225-230.

Location of the mill; possible other sources of coal; Sunnyside coal handling at Fontana; weathering of Utah coals; screen test; shatter test; tumbler; physical fuel values; coke produced from 100% unwashed Sunnyside; washed Sunnyside; addition of pitch.

1-16. **New Canadian Ore Deposit Has High Iron Content.** *Steel,* v. 118, Feb. 25, '46, p. 102.

Six channel samples taken from the deposits and assayed by the Provincial Department of Mines, Toronto, analyzed 64.41, 67.94, 68.14, 68.24, 66.33 and 61.79% iron, respectively.

1-17. **Alumina Extraction by the Lime Sinter and Lime-Soda Sinter Processes.** R. E. Grim and others. *Illinois State Geological Survey Bulletin,* no. 69, 1945, 77 p.

Results of an investigation undertaken for the WPB to determine the amenability of various types of clay minerals to alumina extraction.

1-18. **The Krupp-Renn Process.** *Metal Treatment,* v. 12, Winter, '46, p. 263-271.

Some details of the Krupp-Renn process, extracted from a captured German document, and a number of results of its application to the treatment of low grade raw materials.

1-19. **Evaluation of Some Binders for Use in Pelletizing Slimes.** T. A. Klinefelter. *Bureau of Mines, Report of Investigations* 3846, Dec. '45, 13 p.

The study had two objectives: first, to find a binder of sufficient strength throughout the early stages of curing and heat treating and, second, to determine the degree of curing and heat treatment necessary to prevent disintegration under normal working conditions.

1-20. **Metallurgical Treatment of Cobalt Ores From the Goodsprings Mining District, Nevada.** F. Keith Shelton. *Bureau of Mines, Report of Investigations* 3836, Dec. '45, 34 p.

The cobalt oxide mineral, stainerite ($Co_2O_3 \cdot H_2O$), is amenable to concentration commercially by flotation in hot pulps of finely ground ore. Satisfactory reagents are barium sulphide, sodium silicate, American Cyanamid Reagent 301, and pine oil. Also, gravity concentration by tabling followed by flotation of the table middlings and tailings is successful on relatively high grade cobalt ores. 34 ref.

1-21. **Rapid Specific-Gravity Method for Estimating the Iron Content of Birmingham, Ala., Red Ores.** I. L. Feld, G. D. Coe and Will H. Coghill. *Bureau of Mines, Report of Investigations* 3838, Jan. '46, 6 p.

Method consists of adding a convenient indefinite quantity of air-dried or wet sample to a tared volumetric flask

containing water. The contents of the flask are adjusted in volumes to the calibration mark (the sample level must be lower than the water level). The flask and contents are weighed. Calculation gives the specific gravity of the sample.

1-22. **Diamond Drilling as Applied to Ore Production. Part II.** *Engineering and Mining Journal,* v. 147, Jan. '46, p. 58-64.

Current practice of United States Vanadium Corp., International Nickel Co. of Canada, Bethlehem Steel Co., Republic Steel Corp., Chelan Division of Howe Sound Co., and Mountain Copper Co.

1-23. **Moroccan Mine Develops Unusual Classifier Design.** E. J. Breton. *Engineering and Mining Journal,* v. 147, Jan. '46, p. 77-78.

Description of mining and milling lead-zinc ore at the Mine de Gundafa in Morocco. Description of an unusual hydraulic-type classifier designed to make 100-mesh separation on minus 80-mesh feed.

1-24. **Cast Iron in the Mining Industry.** K. A. DeLonge. *Canadian Metals and Metallurgical Industries,* v. 9, March '46, p. 30-31.

Good fatigue strength, high damping capacity and ability to distribute localized stress of quality gray iron gives it a design strength not far inferior and sometimes superior to steel. Development of hard and tough alloyed white irons enables millman to reduce ore dressing costs substantially through lowering the amount of metal worn away per ton of ore handled and by lengthening the interval between shutdowns for the replacement of worn parts.

1-25. **An Investigation of Detachable Bits.** Ralph E. Sinke. *Western Miner,* v. 19, March '46, p. 46-53.

The primary reason for investigating the use of detachable bits was the desirability of eliminating the handling of a large quantity of drill steel in the shaft, thus allowing more time for the hoisting of ore. In addition, a detachable bit was desired which would result in less overall drilling cost, or at least not more, than conventional drill steel. For every operation, the equipment to be used should be that best prepared to satisfy the requirements imposed on it by local conditions.

1-26. **Some Notes on Vanadium Deposits.** D. C. McLaren. *Mining Journal,* v. 29, March 15, '46, p. 5-7.

Brief discussion of location and type of vanadium deposits.

1-27. **Electroprocess Developed to Produce Metallic Manganese.** Glenn L. Allen, J. H. Jacobs and J. W. Hunter. *Chemical and Metallurgical Engineering,* v. 53, March '46, p. 106-109.

Summarizes three years of pilot plant development work and economic feasibility studies on a proposed 40-ton per day plant in the Las Vegas area. On the basis of pilot plant operation it is believed that total production costs using low-grade domestic ores can be held down to 7.5c per lb. of metal with a purity of 98.5 to 99.9%.

1-28. **Growth of Light Metals Assured—Tonnages Uncertain.** James L. Head. *Engineering and Mining Journal,* v. 147, Feb. '46, p. 98-100.

1945 review; bauxite for alumina; kalunite and ancor; monolith and Columbia; combination process; conservation still wise; new finds in Caribbean; magnesium from Dow; swift developments; outlook for light metals.

1-29. **New Reagents and Methods Mark Ore-Dressing Advance.** S. A. Falconer. *Engineering and Mining Journal,* v. 147, Feb. '46, p. 104-107, 167-168, 170.

1945 review; grinding; classification; heavy-media separation; gravity concentration; flotation reagents; iron ore flotation; pilot plant; flotation machines; cyanidation; mill control devices; complex sulphide ores; three-metal separation; nonsulphide and nonmetallic ores.

1-30. **Beneficiation of Iron Ore Draws Continued Attention.** E. W. Davis. *Engineering and Mining Journal,* v. 147, Feb. '46, p. 108-110.

Research and production activities of various producers in the United States.

1-31. **Ore Preparation.** P. F. Grove. *Iron and Steel,* v. 19, April '46, p. 139-141.

Methods of electric control and operation for large material handling plants.

1-32. **New Methods Cut Costs for Chamberlain Manganese.** Leon Dupuy, W. A. Calhoun, R. T. C. Rasmussen. *Engineering and Mining Journal,* v. 147, April '46, p. 93-96.

Only in the field of placer mining could a simpler method of mining and milling be found than the one described in this article. This latest, and simplest, method advocated for working the Chamberlain, S. D., manganese ores involves mining the ore with scrapers and milling it with conical rolls. Costs are sharply reduced, compared with previous proposals.

1-33. **Effect of Sized and Nodulized Mesabi Iron Ores on Blast Furnace Performance.** Herman F. Dobscha. *American Iron and Steel Institute Advance Copy,* May 23, '46, 15 p.

Blast furnace tests showed distinct advantages in increasing iron production and decreasing fuel consumption when using prepared iron ores. It is believed that with continued processing of ores and with continued furnace operation using these ores an ultimate production rate in excess of 1700 tons of iron per day could be maintained.

1-34. **Determining Rates of Deoxidation of Iron Oxide Materials in Reducing Gases.** E. P. Barrett and C. E. Wood. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, May '46, p. 285-286.

In determining the rates of deoxidation of iron ores in reducing gases, iron oxide material is heated in an alloy container suspended from a balance, and reducing gas at a controlled rate of flow is passed through the heated material. Loss in weight (oxygen) is recorded at intervals until almost constant weight is obtained. Method is simple, accurate, and rapid.

1-35. **Converting Beryl Ore.** B. R. F. Kjellgren. *Metal Industry,* v. 68, May 17, '46, p. 385-388.

Production of beryllium oxide from beryl ore, and of beryllium copper in an electric arc furnace by direct reduction of the oxide with carbon in the presence of copper. Data are given on laboratory results and on production on an industrial scale. (Paper for Electrochemical Society.)

1-36. **Production of Alumina in War Time.** *Chemical Age,* v. 54, May 25, '46, p. 573-576.

Discussion and comparison of the Seailles-Dyckerhoff, Bayer, and ammonium bisulphate methods for producing alumina.

1-37. **Reclamation of Wet Process Waste—The Use of Metallurgical Byproduct Liquors.** A. G. Arend. *Chemical Age,* v. 55, July 6, '46, p. 15-18.

Two methods for recovery of sodium sulphate from byproduct liquors of the wet extraction method for copper ore are described. Earlier evaporation method is being supplanted by the newer refrigeration method for precipitating sodium sulphate at a temperature of—3°C.

1-38. **The Dressing of Copper Ores.** F. B. Michell. *Mine & Quarry Engineering,* v. 11, May '46, p. 107-112.

Types of ore and the general methods for simple sulphide ores and mixed ores. Examples from practice involving all types of flowsheets.

1-39. **Cerium and Thorium.** E. F. Roots. *Western Miner,* v. 19, Aug. '46, p. 50-56.

Description of cerium and thorium minerals; location of mineral deposits; production and consumption; mining and milling; marketing and shipping; extraction from monazite; byproducts and utilization; grades and prices. Flow sheets for milling of fine monazite sand and for extraction of thorium nitrate and metallic cerium. 12 ref.

1-40. **Coronado's Republic Mine.** *Mining World,* v. 8, Aug. '46, p. 42-45.

Brief description of copper mining and concentration procedures; flowsheet of the concentration plant.

1-41. **Iron Ore Washing in 36th Year in Minnesota Mining.** *Skillings' Mining Review,* v. 35, Aug. 17, '46, p. 1, 15.

History and present status.

1-42. **Effect of Sized and Nodulized Mesaba Iron Ores on Blast Furnace Performance.** Herman F. Dobscha. *Blast Furnace and Steel Plant,* v. 34, Aug. '46, p. 979-985.

Two identical blast furnaces were used in the test program, beneficiated ores being charged to one and normal ones to the other; after two months the burdens were reversed. Use of prepared ores resulted in increased iron production and decreased fuel consumtion.

1-43. **Making Low Grade Iron Ore Pay.** A. J. Wiseley. *Mining Congress Journal,* v. 32, Aug. '46, p. 22-24, 64.

Methods of mining, concentration and maintenance practiced by Butler Bros. in Minnesota. Heavy media separation using ferrosilicon is used at two installations.

1-44. **Minerals for Chemical and Allied Industries. A Review of Sources, Uses and Specifications—Part I.** Sydney J. Johnstone. *Industrial Chemist,* v. 22, Aug. '46, p. 477-482.

Specifications and processing methods for aluminum and antimony ores. Uses and composition of bauxite; other sources of alumina; alunite; uses of antimony.

1-45. **Some Properties of the Spinels Associated With Chrome Ores.** G. R. Rigby, C. H. B. Lovell, and A. T. Green. *Transactions of the British Ceramic Society,* v. 45, April '46, p. 137-147.

The preparation and certain properties of the spinels usually considered as constituents of chrome ores are described. The action of hydrogen and oxygen on the spinels, chromite, hercynite and their oxidation products are also reported. 22 ref. (Reprinted from *Bulletin of Refractories Research Association,* no. 65, June '43.)

1-46. **Diamond Drilling Features Mountain Copper's Mining.** John B. Huttl. *Engineering and Mining Journal,* v. 147, Sept. '46, p. 64-68.

Mining and concentration operation on complex copper-zinc ores from Shasta County, Calif. Flow sheet of concentrator and description of the flotation circuits.

1-47. **Balkan Base-Metal Enterprise—Trepca Mines, Ltd.** *Engineering and Mining Journal,* v. 147, Sept. '46, p. 54-60.

Mining and concentration of replacement-type sulphide ore bodies in limestone in Yugoslavia. Lead, zinc, silver and iron are present in substantial amounts. Flow sheet of lead, zinc, and pyrite concentration plant.

1-48. **Screening and Classification in Grinding Circuits.** S. Gray and P. M. Elliott. *Canadian Mining and Metallurgical Bulletin,* no 413, Sept. '46, p. 466-473.

Various types of screening and classification equipment and their applicability to different materials.

1-49. **Fine Screens in a Grinding Circuit.** Walter M. Stephen. *Canadian Mining and Metallurgical Bulletin,* no. 413, Sept. '46, p. 474-478.

Recommends fine wet-screening for closing grinding circuits under certain conditions. Gives results of experimental runs using vibrators and various stainless steel screens in milling of copper-nickel ores.

1-50. **Raw Materials.** *Steel,* v. 119, Sept. 23, '46, p. 124-125.

High grade iron ore reserves are dwindling but beneficiating methods are expected to open up vast new supplies. Foreign sources also will aid. More ore treatment plants to be built in next decade. Mechanical cleaning of coal cuts costs.

1-51. **Sidney's New Mill.** *Mining World,* v. 8, Sept. '46, p. 40-43.

Details of 250-ton zinc-lead concentrator near Kellogg, Idaho, including process flowsheet.

1-52. **Compania Minera de Isla de Pinos.** Clarence Thom. *Deco Trefoil,* v. 10, Aug. '46, p. 3-9.

Details of concentration practice used on a lead-gold-silver ore characteristized by the occurrence of arsenopyrite and stibnite as predominating sulphide minerals, and close association of important amounts of gold and silver.

1-53. **Open-Pit Mining for Manganese.** D. E. Eilertsen and J. W. Feiss. *Mining Congress Journal,* v. 32, Sept. '46, p. 28-33, 39.

Mining and concentration operations of Dominion Manganese Corp., Crimora, Va.

1-54. **Crushing and Grinding Efficiencies.** *Journal of the Chemical, Metallurgical and Mining Society of South Africa,* v. 46, May-June '46, p. 335-345.

Extensive discussion of paper by T. K. Prentice, published in Jan-Feb. '46 issue, on the theory of crushing and grinding as applied to ore concentration. (Reprinted from *Bulletin of the Institution of Mining and Metallurgy—London.)*

1-55. **The Dithionate Process for Recovery of Manganese From Low-Grade Ores.** S. F. Ravitz, W. F. Wyman, A. E. Back, and K. E. Tame. *Metals Technology,* v. 13, Sept. '46, T. P. 2064, 10 p.

Process developed by Bureau of Mines; its chemistry; advantages and disadvantages; process flowsheet. Results of laboratory, larger scale batch, and continuous semi-pilot plant tests.

1-56. **German Iron Ores Yield Vanadium.** R. P. Fischer. *Metals Technology,* v. 13, Sept. '46, T. P. 2070, 5 p.

Information concerning German practice in vanadium concentration and recovery and German research in vanadium recovery.

1-57. **Principles of Mineral Conservation.** W. M. Myers. *Mineral Industries Experiment Station Circular 25, Pennsylvania State College,* 19 p.

Need for conservation and practical methods of application to the various types of mineral resources. A few statistics included.

1-58. **Making Tin Flotation Work—No. II. Oploca Ore.** A. M. Gaudin and Falih Ergunalp. *Engineering and Mining Journal,* v. 147, Nov. '46, p. 72-74.

A combination leaching and flotation process is recommended for Oploca tin ore from southern Bolivia. The ore is beneficiated by a compound process of roasting, comminution, and gravity concentration.

1-59. **Concentrating Operations of the Mahoning Mining Company, Rosiclare, Illinois.** Walter E. Duncan. *Mining Technology,* v. 10, Sept. '46, T. P. 2040, 14 p.

Ores consist of complex mixtures of galena, sphalerite and fluorspar in a gangue of quartz, limestone and sandstone. Describes an all-flotation method of concentration for production of lead, zinc, acid-grade and metallurgical-grade fluorspar concentrates. Plant layout is described in detail.

1-60. **Solubility Product and Bubble Attachment in Flotation.** Arthur F. Taggart and M. D. Hassialis. *Mining Technology,* v. 10, Sept. '46, T. P. 2078, 7 p.

Solubility product of lead ethyl xanthate has been determined. An approximate method for estimating the solubility product of collector-coating compounds is described. Minimum concentration of agent was determined

by contact-angle tests on galena and shown to be predictable from solubility product. Explanation is offered for discrepancy between minimum effective collector concentrations in tests in mill operation. Theory is advanced that all conditioning and collecting reactions involving ions are predictable on the basis of solubility product of the least soluble compound involved.

1-61. **Automatic Grinding and Classification by the Tennessee Copper Co.** J. F. Myers and F. M. Lewis. *Western Miner,* v. 19, Oct. '46, p. 47-49.

Equipment consists of ore weighing feeders and wide-open water valves with fixed orifice openings, fed from a constant level water tank. This combination permits grinding and classification to proceed without attention except in case of power outs or equipment failure.

1-62. **The Dressing of Simple Lead and Zinc Ores.** F. B. Michell. *Mine & Quarry Engineering,* v. 12, Oct. '46, p. 105-114.

Treatment of simple ores; examples from practice involving different types of flow sheets.

1-63. **Making Tin Flotation Work. No. 1. Canutillos Ore.** A. M. Gaudin, R. Schuhmann, Jr., and E. G. Brown. *Engineering and Mining Journal,* v. 147, Oct. '46, p. 54-59.

First of four articles reports on successful attempts to concentrate Bolivian tin ores by flotation. Practicable tin-recovery methods have been worked out, and contribution made to the search for a really selective nonsulphide flotation method. Present methods and mineralogy of the ore; direct flotation tests and experimental leaching procedure; suggests a leaching-flotation flow sheet for the ore.

1-64. **A Test to Determine the Lime Abstraction of Iron Ores.** Ellis S. Hertzog. *Bureau of Mines Report of Investigations* 3929, Sept. '46, 10 p.

Study was made in connection with research on the concentration of iron ores. When the iron ores were concentrated by the anionic flotation of lime-activated silica, it was difficult to determine the amount required to obtain optimum results. Lime-abstraction tests were made in an effort to determine the reason for the great variation in lime requirement and to develop a method for measuring the lime-abstraction capacity of an ore. Tests described enabled more accurate estimates of amount of lime required for each new ore to be made.

1-65. **Magnesia From Olivine.** E. A. Gee, Charles E. McCarthy, Frank S. Riordan, Jr., and Morton T. Pawel. *Bureau of Mines Report of Investigations* 3938, Sept. '46, 33 p.

Large tonnages of olivine are available in western North Carolina and Washington State. A hydrochloric acid process was evaluated for the production of magnesium chloride and/or oxide from olivine. As a result of small-scale development work, certain techniques indicated commercial as well as technical feasibility of the process. Includes analytical and control methods, a materials balance and a rough cost estimate, indicating a cost of about $50 per ton of MgO per day. 38 ref.

1-66. **Reconversion Problems in Lead Metallurgy.** G. L. Oldright. *Bureau of Mines Information Circular* 7373, Sept. '46, 4 p.

The most significant recent changes in concentration of lead ores have been made in grinding, classifying, and thickening practices to simplify the flow sheets. Flotation of coarser particles by all flotation methods has been favored to avoid losses incidental to overgrinding the slime, to lessen the amount of flotation reagents, and to avoid the excessive cost of finer grinding. 11 ref.

1-67. **The Geochemistry of Uranium.** S. I. Tomkeieff. *Science Progress,* v. 34, Oct. '46, p. 696-712.

Formation and occurrence of the uranium minerals.

1-68. **Titanium and Zirconium.** W. J. Kroll and A. W. Schlechten. *Metal Industry,* v. 69, Oct. 18, '46, p. 319-322.

Methods that are available for the extraction of these materials.

1-69. **Chino Copper.** *Compressed Air Magazine,* v. 51, Nov. '46, p. 286-291.

Mining and concentration procedures used by the Chino Mines Division of the Kennecott Copper Corp. at Santa Rita, N. Mex.

1-70. **Crushing and Grinding Efficiencies.** L. Ackermann. *Journal of the Chemical, Metallurgical and Mining Society of South Africa,* v. 47, July '46, p. 56-68.

A theory of grinding from which it is concluded that area of new fracture surface formed is approximately proportional to the available power input; less than 1% of the available power input is usefully employed, the balance being evolved mainly as heat. This power wastage is proportional to the average surface area of the ore; energy required is proportional to the number of stages of reduction and to the weight of the ore crushed; useful energy input is used almost entirely in straining the ore particles up to the point of fracture rather than in the actual production of new surface area.

1-71. **Recovery of Alumina From Clay and Shale.** A. G. Arend. *Paint Technology,* v. 11, Aug. '46, p. 305-307.

Advantages and disadvantages of the various methods.

1-72. **Ten Months Milling at Moulton Hill.** A. C. King and T. V. Lord. *Deco Trefoil,* v. 10, Sept. '46, p. 5-12.

Mining and beneficiation operations of the Aldermac Copper Corp. at Moulton Hill mine in Quebec. Gold, silver, copper, lead, and zinc are obtained from the ore. Includes details of preliminary investigations, copper-lead flotation separation, cyanidation of zinc concentrates, crushing and grinding.

1-73. **St. Joe's Balmat Mill—Problem in Four Dimensions.** James Casale. *Engineering and Mining Journal,* v. 147, Nov. '46, p. 56-62.

Details of concentration procedure, including crushing, milling, and flotation flow sheet, used by St. Joseph Lead Co. at Balmat, N. Y. Zinc, lead, and pyrite flotation concentrates are produced.

1-74. **Settling and Thickening.** Fred C. Bond. *Canadian Mining and Metallurgical Bulletin,* no. 415, Nov. '46, p. 546-556.

A method of analysis of thickening tests on finely divided pulps has been developed, with which the required

thickener area can be determined in one calculation. The necessary minimum depth of the thickening tank can also be calculated, using an assumed safe depth of clear solution. The degree of flocculation of pulp can be determined from a thickening test, and expressed as the flocculating diameter, or the particle diameter which marks the limit of flocculations.

1-75. **Copper Losses in Smelter Slags.** A. G. Scobie. *Canadian Mining and Metallurgical Bulletin,* no. 415, Nov. '46, p. 557-573.

During concentration of ore from the Flin Flon mine of the Hudson Bay Mining and Smelting Co., Ltd., silicates high in magnesia have a strong tendency to float and appear in the copper concentrate, where they cause great smelting difficulty. Investigation into the fundamental properties of smelter slags of various compositions, in an attempt to find a solution to the difficulty is described. The effects of various constituents were determined and charted.

1-76. **Preparation of Manganese Electrolyte From Manganese Mattes and Pure Oxides.** David Schlain. *Bureau of Mines Report of Investigations* 3976, Oct. '46, 16 p.

Pyrometallurgical and hydrometallurgical processes for the production of mattes and oxides of relatively high purity from low-grade manganese ores. Present investigation deals with the use of such products for the preparation of manganese electrolyte with a view toward making available for the production of electrolytic manganese the large reserves of domestic manganese ores that are too low in grade or unsuitable chemically for direct treatment. Experimental results, which were encouraging, are described and tabulated.

1-77. **Rationaliseringsstravanden Inom Svensk Jarnmalmsanrikning. (Rationalization in Swedish Iron Ore Dressing.)** Sture Mortsell. *Jernkontorets Annaler,* v. 130, no. 9, '46, p. 369-460; discussion, p. 460-476.

Recent developments in Swedish iron ore dressing machinery. Results of a series of ball mill grinding tests illustrate the influence of ball size on grinding and on quality of product. Problem of locked particles of magnetite ores has led to thorough studies of the liberation properties in comminution of different ores, including elutriation analyses. Examples are given of combining concentration in jigs or shaking tables with magnetic concentration. Phosphorus content of certain ores can be considerably reduced by far-reaching concentration. Experiments were also made with leaching in acids, for elimination of pyrrhotite flotation at a very low pH has given good results. Also discusses supervision, control of operation, and planning of ore dressing plants and gives data of several Swedish plants. 59 ref.

1-78. **Colorado Silver Bell's New Mill.** *Mining World,* v. 8, Nov. '46, p. 39-41.

Mining and concentration operations. Lead, gold, and silver are produced in a new 150-ton flotation plant.

1-79. **Den Svenska Bergshanteringens Utveckling Under de Senaste Aren. (Development of Swedish Mining During**

War.) Martin Wiberg. *Jernkontorets Annaler*, v. 130, no. 8, '46, p. 286-296, 297, 312.

A review of Swedish mining and metal production during the past decade. New methods of mining and metal production are described. Illustrated by a series of graphs and diagrams.

1-80. **Ten Months Milling at Moulton Hill. The Solving of a Very Complex Ore. Part II.** A. C. King and T. V. Lord. *Deco Trefoil*, v. 10, Oct. '46, p. 5-12.

Flotation procedures, sampling, thickening and filtration, and microscopic examination of mill products. Ore is composed of intimately associated sulphides. In treating, pyrite and sphalerite are depressed, while chalcopyrite, galena, and some of the precious metals are floated. Copper, lead, and zinc are recovered. (Concluded.)

1-81. **Annealing Ore.** *Iron and Steel*, v. 19, Nov. '46, p. 615-616.

Processing of annealing ore won from Florence Mines, at Egremont, Cumberland.

1-82. **The Dressing of Complex Lead-Zinc Ores.** F. B. Michell. *Mine & Quarry Engineering*, v. 12, Nov. '46, p. 135-144.

Selected flow sheets to illustrate modern practice.

SECTION II

SMELTING AND REFINING

2-1. **The German Steel Industry.** T. W. Lippert. *Iron Age,* v. 156, Dec. 20, '45, pp. 54-59.

High production, little damage and only a few technical innovations characterized steelmaking units that armed the Nazi army. German all-basic open-hearth practice now being tried in U. S.; number of other minor practices warrant serious consideration.

2-2. **Electric Steelmaking in the Arc Furnace.** Conrad Wissmann. *Electrochemical Society Preprint* 88-12, 1945, 7 pp.

Process of steelmaking in electric arc furnace reviewed. Advantages of arc furnace over other types of steelmaking furnaces. Fundamental principles presented, notably those applied to the acid arc furnace process.

2-3. **Some Thoughts on Experimental Electric Arc Furnace Smelting.** H. S. Newhall. *Electrochemical Society Preprint* 88-13, 1945, 7 pp.

Discussion covers furnace design, choice of phase electrodes, refractories, sizing of charge components, and interpretation of experimental results.

2-4. **Electric Induction Steel "E.I.S.".** Frank T. Chesnut. *Electrochemical Society Preprint* 88-17, 1945, 7 pp.

Summary of present status of the application in steel melting of high fequency induction furnace. Principles of induction heating; how, where, and why it is used in steel melting industry. Selection of frequency, advantages of high frequency furnace over others, economy of plant and operation, and most appropriate furnace sizes discussed.

2-5. **Chromium Steels.** R. G. Waite. *Iron & Steel,* v. 18, Oct. '45, pp. 455-456.

Establishing basic open-hearth practice for optimum recovery.

2-6. **Basic Electric Steelmaking.** M. V. Healey. *General Electric Review,* v. 48, Nov. '45, pp. 55-57.

Describes the behavior of gases in the steel during meltdown, boiling period and reducing period. To prevent reabsorption of gases at end of boiling period, author suggests modification of practice consisting of elimination of reducing period and tapping of the heat soon after the

killing boil. Predicts less gas, less nitrogen, less time consumption, less power, longer refractory life.

2-7. **Cooling Beds and Transfers.** Charles L. Raisig. *Iron & Steel Engineer,* v. 22, Nov. '45, pp. 37-47.

Selection of correct cooling bed, with flexibility to meet all operating requirements, requires careful analysis. Several modern installations described in detail.

2-8. **Blast Furnace Theory—Part I.** F. Mobey. *Iron and Steel,* v. 18, Nov. '45, pp. 481-485.

Reduction and carburization of iron in the solid state and carbon deposition. 34 ref.

2-9. **Blast Furnace. Part I—Distribution of Materials.** H. L. Saunders and R. Wild. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 552-559.

The use of models; experiments with spherical materials; summary of variables; experiments with materials of irregular shape; discharge of a homogeneous burden; discharge of a mixed burden; segregation.

2-10. **Tropenas-Converter Blowing.** S. T. Jazwinski. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 563-564.

Changes in the converter-flame spectrum; discussion on the observed spectrum changes.

2-11. **Basic O.H. Slags.** T. F. Pearson. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 576-579.

Improvement of their citric acid solubility when containing fluorspar.

2-12. **Acid Open-Hearth Steel.** J. R. Rait. *Iron & Steel,* v. 18, Dec. '45, pp. 647-654.

Theory of the removal of non-metallic inclusions. An important factor is a good open boil. Various methods of deoxidation are mentioned and compared. Casting pit refractories as a source of metallic inclusions are discussed from the standpoint of steel-slag equilibria. (Lecture given to the Twenty-Fourth Open-Hearth Conference, British Iron and Steel Research Association.) 10 ref.

2-13. **Blast-Furnace Theory—II.** F. Mobey. *Iron & Steel,* v. 18, Dec. '45, pp. 629-633.

Combustion of carbon in the hearth, slag constitution and properties, desulphurization in the blast furnace and the behavior of phosphorus are dealt with.

2-14. **Control of Tropenas-Converter Blowing by Direct-Vision Spectroscope.** S. T. Jazwinski. *Engineering,* v. 160, Nov. 30, '45, p. 441.

Description and method of using a simple miniature spectroscope to help determine changes in converter-flame during a blow. Colors observed during various stages of a blow are given.

2-15. **Talks About Steelmaking—Big Crucible Ingots.** *British Steelmaker,* v. 11, Dec. '45, pp. 554-556.

Discusses Huntsman crucible steel process. Describes casting of 30-ton ingot of crucible steel.

2-16. **Refractory or "Fireless Cooker" Method of Producing Magnesium.** E. G. De Coriolis. *Metals Technology,* v. 12, Dec. '45, T. P. 1941, 20 pp.

"Fireless cooker" process; laboratory and experimental plant developments; production of briquettes; reaction rates; design of condenser; choice of refractory; pilot plant; discussion of results; potentialities of the refractory-chamber process.

2-17. **Electrolytic Manganese in Acid Steel Tests at Atlas Steel Casting Co. and the Detroit Steel Casting Co.** R. T. C. Rasmussen. Bureau of Mines Report of Investigations 3830.

When electrolytic manganese produced in a pilot plant at Boulder City, Nev., was substituted for the usual imported ferromanganese in full-scale commercial heats of steel at the cooperating plants, it proved entirely satisfactory and the carbon steels obtained had slightly better physical properties.

2-18. **A Study of Certain Factors in the Hydrometallurgy and Electrodeposition of Cobalt.** F. K. Shelton, R. E. Churchward, J. C. Stahl, and G. F. Livingston. Bureau of Mines Report of Investigations 3832.

Further developments upon a chemical and electrolytic process which will materially facilitate the production of cobalt from domestic ores.

2-19. **The Use of Mexican Graphite Lowers Openhearth Melting Costs.** R. J. Zemanek. *Blast Furnace and Steel Plant,* v. 34, Jan. '46, p. 100-104.

Quantity of lime used; position of graphite in charge; way to charge an acid furnace. 4 ref.

2-20. **Production of Nickel and Chrome Steels From Laterite Ores.** T. F. Baily. *Electrochemical Society Preprint* 88-29, 1945, p. 347-355.

The only nickel expansion project built during World War II was the Nicaro nickel development utilizing the laterite nickel-chromium-iron ores of Cuba. Experiments were carried out in the electric arc furnace applying selective reduction of these Cuban ores. The basic principle is that nickel oxide is more readily reduced than iron oxide and iron oxide more readily reduced than chromium oxide.

2-21. **Mineralogical Observations on Some Basic Openhearth Slags.** S. O. Agrell. *Iron and Steel Institute Advance Copy,* Dec. '45, 37 p.

Principal phases that may occur in basic openhearth tapping slags. The chemical composition, optical properties, and mutual relations of the phases occurring in a number of slags are given, and the variations of phase assemblages from two casts are described in detail. 46 ref.

2-22. **Developments in the Iron and Steel Industry During 1945.** W. H. Burr. *Iron and Steel Engineer,* v. 23, Jan. '46, p. 53-65.

Blast furnaces; steelmaking; rolling mills; finishing; furnaces and control; materials handling; mechanical developments; electrical developments.

2-23. **The Blast Furnace Skip Hoist—III.** Gordon Fox. *Iron and Steel Engineer,* v. 23, Jan. '46, p. 73-79.

Considers the entire charging operation and how its requirements affect skip hoist design.

2-24. **Billet-Size Ingots.** R. W. Scholl. *Steel,* v. 118, Jan. 21, '46, p. 88-89, 104, 106, 108.

Small ingot practice eliminates pouring platform. Pins in top of big-end-up ingots facilitate stripping. Anti-piping compounds are used instead of hot tops. Ingot segregation is reduced to a minimum. Direct rolling of ingots to finished products eliminates reheating.

2-25. **Mineralogical Observations on Some Basic Open-hearth Slags.** S. O. Agrell. *Iron and Steel Institute Advance Copy,* Dec. '45, p. 1-37.

Variation of phase assemblages is summarized by plotting the different assemblages on the ternary diagram CaO-P_2O_5-SiO_2, and it is shown that they fall into definite fields on this diagram. 46 ref.

2-26. **Manufacture of Sponge Iron in Periodic Brick Kilns.** Kenneth M. Smith and S. E. Burton. *Bureau of Mines Report of Investigations* 3841, Dec. '45, 38 p.

Studies proved that high grade sponge iron can be made in periodic brick kilns without alterations. From the data obtained a plan was originated for experimental commercial-scale production of sponge iron.

2-27. **Dual System for Cleaning Blast Furnace Gas.** *Steel,* v. 118, Jan. 28, '46, p. 144, 146.

Details of Dovel type combination dry gas cleaner and washer.

2-28. **The Theory of Gases in Aluminum.** L. W. Eastwood. *Light Metal Age,* v. 4, Jan. '46, p. 10-11.

Physical, chemical, and mathematical laws involved in the absorption and diffusion of gases in aluminum.

2-29. **The Low Temperature Gaseous Reduction of Magnetite Ore to Sponge Iron.** O. George Specht and Carl A. Zapffe. *American Institute of Mining and Metallurgical Engineers, T. P.* 1960, 1946, 41 p.

An exhaustive examination of all previous work on low-temperature gaseous reduction. Experimentation on the reduction of a magnetite with hydrogen. Development of certain thermodynamic relationships in reduction, with a summarized depiction of the factors in the general process. 228 ref.

2-30. **Drains 640-Ton Salamander From Stack in an Hour.** *Steel,* v. 118, Feb. 11, '46, p. 114, 116, 119-120.

Two holes in concrete hearth foundation, 2 ft. apart, serve as guides for oxygen lance which provides well-defined notch, 3 to 4 in. diameter. Molten metal is cast into a 200x28-ft. pit in 2-ton pigs to facilitate handling by a magnet. Repair work started three days after removal of metal.

2-31. **The Making of Electric Furnace Alloy Steels.** W. J. Reagan. *Blast Furnace and Steel Plant,* v. 34, Feb. '46, p. 236-240.

Furnaces with shell diameters of 16 and 17 ft. with charging capacities of 85,000 and 110,000 lb. utilized. Furnaces are swing roof-top charge-type. Production with all cold charge ranges from 8 to 12 tons per hour. Discusses selection of material, melting period, slags and finishing slag. (Paper for Pittsburgh Chapter, American Society for Metals.)

2-32. **The Perrinization of Basic Bessemer Steel in France.** *Metallurgia,* v. 33, Jan. '46, p. 115-116.

Rapid metallurgical process which consists of a violent intermixing of molten steel with suitable molten slags which have intensive purification properties.

2-33. **Blast-Furnace Theory. Part 3.** F. Mobey. *Iron and Steel,* v. 19, Jan. '46, p. 3-6.

Behavior of silicon and manganese and Wüst's theory of the manner in which they are reduced. Occurrence and significance of cyanides and hydrogen, and a short account of some of the physical principles of the blast furnace process. 28 ref.

2-34. **Basic O.H. Furnaces.** J. McKay and W. G. Cameron. *Iron and Steel,* v. 19, Jan. '46, p. 13-21.

General practice at Lanarkshire Steel Co. Steel plant layout; furnace design and construction; gas producers; waste heat boilers; water cooling; furnace operation; phosphorus throw-back; pitside practice; gas-dried ladles. (Paper for West of Scotland Iron and Steel Institute.)

2-35. **High Sulphur Steel.** G. A. Ferris and H. Clark. *Iron and Steel,* v. 19, Jan. '46, p. 23-26, 36.

Emphasizes need for care in the openhearth, soaking pit and blooming mill.

2-36. **Blast-Furnace Slag.** H. O. Wicks. *Iron and Steel,* v. 19, Jan. '46, p. 27-29.

Process described produces a light-weight building material offering many possibilities.

2-37. **The Refining of Copper Residues.** O. P. Einerl and Frederic Neurath. *Chemical Age,* v. 54, Feb. 2, '46, p. 139-143.

Commercial problems; sources of supply; partial refining and pretreatment; reverberatory furnace.

2-38. **Production of Magnesium From Olivine.** E. C. Houston. *Metal Treatment,* v. 12, Winter, '46, p. 287-288, 290.

Describes in some detail the pilot plant process successfully evolved by T.V.A. laboratories working in conjunction with the Georgia State Engineering Station. (From *Metals Technology,* April 1945.)

2-39. **Blast Furnace Operation Under Elevated Top Pressure.** Frank Janecek. *Iron and Steel Engineer,* v. 23, Feb. '46, p. 88-94, 101.

Recounts the troubles and results of operating a blast furnace with elevated top pressure; such operation shows definite advantages when mechanical difficulties are overcome. For instance, because of better wind distribution, it becomes possible for a large diameter blast furnace to produce tonnages per square foot of hearth area which have been accredited only to small furnaces.

2-40. **Blast Furnace Theory. Part IV.** F. Mobey. *Iron and Steel,* v. 19, Feb. '46, p. 47-51.

Thermal principles of the blast furnace. Johnson's critical temperature theory and Korevaar's ideas of heat compression and the counter-current principle. Concluding discussion of direct reduction in the blast furnace. 26 ref.

2-41. **Coke Oven and B. F. Practice.** J. H. Patchett. *Iron and Steel,* v. 19, Feb. '46, p. 63-68.

Progress in recent years and possible future developments. (Presidential Address to the Cleveland Institution of Engineers.)

2-42. **Waste Heat Recovery.** *Metal Industry,* v. 68, March 8, '46, p. 183-187.

Refining of copper and its alloys. The zinc industry. (From a symposium presented to the Institute of Fuel.)

2-43. **Electrolysis of Manganese Into a Metal Cathode From Suspensions of Manganese Oxide and Carbon in Molten Manganese Chloride.** Burke Cartwright and S. F. Ravitz. *Electrochemical Society Preprint* 89-4, April 15, '46, p. 73-82.

Manganese was electrodeposited at 700° C. into a molten tin cathode from manganous chloride melts and from suspensions of manganese oxide and carbon in fused manganous chloride. The possibilities of using this method for the production of pure manganese or usable manganese alloys are discussed, and zinc rather than tin is suggested as probably being the most suitable cathode metal for either purpose.

2-44. **The Production of Beryllium Oxide and Beryllium-Copper.** Bengt R. F. Kjellgren. *Electrochemical Society Preprint* 89-5, April 15, '46, p. 83-94.

The acid resistant crystalline beryl ore is converted to a reactive form by melting the ore in an electric furnace and quenching the melt. The reactive material is treated with sulphuric acid and beryllium sulphate is produced by a crystallization process. The beryllium sulphate is converted to beryllium oxide by heating. The production of beryllium-copper in an electric arc furnace by direct reduction of beryllium oxide with carbon in presence of copper is described. Data are given on laboratory results and on production on an industrial scale.

2-45. **Electrolytic Refining of Lead.** W. H. Dennis. *Mine and Quarry Engineering,* v. 11, March '46, p. 55-58.

Preparation of anodes and cathodes; tank arrangement and connections; electrolyte; plant operations; slimes.

2-46. **The Making of Electric Furnace Alloy Steels. Part II.** W. J. Reagan. *Blast Furnace and Steel Plant,* v. 34, March '46, p. 345-349, 354.

Cold melting practice and triplexing process; processing and testing; conditioning and rolling; finishing department.

2-47. **Factors Affecting Yield of Medium-Carbon, Semikilled Steel.** E. C. Sorrells. *Industrial Heating,* v. 13, March '46, p. 508, 510-511.

Discusses the higher yield and reduced segregation in medium-carbon, semikilled steel as compared to rimmed and capped steels. (Condensation of paper presented before American Institute of Mining and Metallurgical Engineers.)

2-48. **The Refining of Copper Residues—II.** O. P. Einerl and Frederic Neurath. *Chemical Age,* v. 54, March 2, '46, p. 235-239.

Working the reverberatory furnace. Discussion of nickel removal and chemistry of slags.

2-49. **Few Changes Mark Year in Nonferrous Metallurgy.** Carle R. Hayward. *Engineering and Mining Journal,* v. 147, Feb. '46, p. 95-97.

1945 review. Among interesting items noted are: the unique system of firing reverberatories at Cerro de Pasco; use of high vacuum to remove zinc from lead; the outstanding paper on improvements in metallurgy at Noranda; scholarships in metallurgy have been set up by the Consolidated Mining and Smelting Co. of Canada.

2-50. **Talks About Steelmaking: Steelmaking Alloys.** Harry Brearley. *British Steelmaker,* v. 12, March '46, p. 120-123.

Manganese; ferrochromium; nickel.

2-51. **Slags and Fluxes. Part I.** Henry Lepp. *Metal Industry,* v. 68, March 15, '46, p. 203-205.

Use in metallurgy throughout the ages. Early extraction of metals from ores. Alchemy; Egyptian metallurgy; Greek metallurgy; the Middle ages; secret methods; degassing; chemical and physical aspects. 13 ref.

2-52. **Slags in Acid Electric Steelmaking.** Conrad C. Wissmann. *Metal Progress,* v. 49, April '46, p. 735-738.

Last of a series of articles on acid steelmaking in which the author has tried to state in simple language some of the most commonly accepted melting methods, and also to describe those considered to give the best steel. It has stressed primarily the importance of inclusions.

2-53. **Slags and Fluxes. Part II.** Henry Lepp. *Metal Industry,* v. 68, Mar. 22, '46, p. 227-228.

Defines in exact terms the meaning of such common words as "slag", "flux" and "dross". Shows how, by the modern study of thermodynamics, great advances were made in steelmaking, metal refining and foundry practice.

2-54. **Alloy and Toolsteel Manufacture in India.** P. H. Kutar. *Metallurgia,* v. 33, March '46, p. 261-264.

Armor plate developed and produced on commercial scale within four months in India. Permanent magnet steels, silicon steels and toolsteels also produced. High speed steel production continues.

2-55. **Slags and Fluxes. Part III.** Henry Lepp. *Metal Industry,* v. 68, March 29, '46, p. 252.

Everyday process of desulphurization of molten iron and copper is examined. Chemical reactions involved are discussed in detail, leading to an introduction to the analysis of the various processes by thermodynamics.

2-56. **The Use of Graphite for Reboiling Soft Melt Heats.** R. Russell Fayles. *Blast Furnace and Steel Plant,* v. 34, April '46, p. 52-54, 78-79.

Soft heat—definition and causes; material and method of addition; advantages of graphite.

2-57. **Blast Furnace Theory.** F. Mobey. *Blast Furnace and Steel Plant,* v. 34, April '46, p. 487-490, 491, 497, 510, 511.

Discusses the various reactions that take place in the blast furnace during operation. 17 ref.

2-58. **Slags and Fluxes—IV.** Henry Lepp. *Metal Industry,* v. 68, April 5, '46, p. 266-268.

Thermodynamic aspect of the desulphurization of copper by means of basic slags. Good practical results claimed for the use of barium carbonate for this purpose and also for the use of thermodynamic analysis for solving slag problems.

2-59. **Alloy and Toolsteel.** P. H. Kutar. *Iron and Steel,* v. 19, April '46, p. 151-157.

Development of manufacture in India during World War II.

2-60. **A.I.M.E. Openhearth Meeting.** *Iron Age,* v. 157, May 2, '46, p. 65-71.

Subjects of papers presented include: The effect of openhearth charging rate on production; effect on costs of furnaces with one checker at each end; desulphurizing cupola iron for openhearth use; substitution of coke for pig iron in openhearth charge; new refractories and basic-lined openhearths.

2-61. **An Equilibrium Study of the Distribution of Phosphorus Between Liquid Iron and Basic Slags.** Theodore B. Winkler and John Chipman. *Metals Technology,* v. 13, April '46, T.P. 1987, 24 p.

Series of experimental heats was made in an induction furnace to study the factors controlling the distribution of phosphorus between a molten iron bath and a basic slag at equilibrium. Radioactive phosphorus was introduced as a tracer. Dephosphorization has been found to be improved by: *(a)* decreased temperature; *(b)* increased iron oxide content of slag and metal; *(c)* increased base-acid ratio of the slag (increased lime content, increased magnesia content, and increased manganese oxide content of the slag, and decreased silica content). Fluorspar additions to the slag have no adverse effect on the dephosphorizing power of the slag. 16 ref.

2-62. **Sulphur Equilibria Between Liquid Iron and Slags.** Nicholas J. Grant and John Chipman. *Metals Technology,* v. 13, April '46, T.P. 1988, 16 p.

Series of experimental heats was made in an induction furnace for the purpose of studying the equilibrium distribution of sulphur between the metal and an assortment of basic slags ranging from strongly basic to slightly acidic. An extremely wide range of slag compositions in both the simple and complex slag systems was investigated, wherein temperature was an additional variable. 30 ref.

2-63. **The Blast-Furnace Process and Means of Control.** T. L. Joseph. *Metals Technology,* v. 13, April '46, T.P. 2021, 22 p.

Henry Marion Howe Memorial Lecture, 1946. Postwar shifts in emphasis; basic features of smelting process; arrangement of material in furnace; patterns of gas distribution inherent to present raw materials and charging methods; greater permeability needed in area between walls and center; iron analysis varies with temperature; means for controlling gas flow; partially fluidized stock and channeling; will large furnaces solve existing problems; inactive central core increases with hearth diameter; importance of blast temperature; potentialities of beneficiated raw materials.

2-64. **The Refining of Copper Residues.** O. P. Einerl and Frederic Neurath. *The Chemical Age,* v. 54, April 6, '46, p. 369-372.

Variations of the reverberatory process including the Lissauer process, blast-furnace process, characteristics of slags and conversion of the copper matte. 25 ref.

2-65. **Smelting Low-Grade Ores by the Krupp-Renn Process.** *Iron Age,* v. 157, May 9, '46, p. 70-74.

Details of the Krupp-Renn process, extracted from a captured German report, and a number of results of its applications.

2-66. **Bunker Hill Plant Recovers Metallic Cadmium From Fume.** John B. Huttl. *Engineering and Mining Journal,* v. 147, April '46, p. 82-85.

The following major operations are carried out in the plant: *(a)* breaking or mulling cadmium fume in a small ball mill and subsequent leaching of the resultant pulp; *(b)* precipitation of pregnant solution; *(c)* briquetting and retorting precipitate; and *(d)* casting molten metal into bars.

2-67. **The Modern Blast Furnace.** T. J. Ess. *Iron and Steel Engineer,* v. 23, April '46, p. BF-17-74.

Evolution of the blast furnace over the past 50 to 70 years. Average performance of some furnaces. A complete tabulation of blast furnaces existing in the United States at present. 57 ref.

2-68. **The Production of Beryllium.** *Chemical Age,* v. 54, April 13, 1946, p. 403-404.

Treatment of the raw ore; conversion to chloride; electrolytic extraction; metal refining by melting first under a hydrogen atmosphere, finally in vacuum.

2-69. **Practical Interpretation of Theoretical Steelmaking for the Benefit of Management and Operator.** C. F. Christopher. *Blast Furnace and Steel Plant,* v. 34, May '46, p. 587-591, 607-609.

Discusses openhearth furnace.

2-70. **The Use of Scrap in the Blast Furnace.** Kurt Neustaetter. *Blast Furnace and Steel Plant,* v. 34, May '46, p. 592-593, 595-599, 627, 631-632.

Discusses the problem of how and where to charge scrap in order to derive the maximum benefit from its use.

2-71. **The Effects of Variations in Raw Materials on Basic Openhearth Operations and Production.** Charles R. FonDersmith. *American Iron and Steel Institute Advance Copy,* May 23, '46, 24 p.

Variations considered are classified as: metallic components—pig iron, scrap; oxidizing elements—mill scale, sinter, ore; slag-making materials — limestone, burned lime, fluorspar; hearth and repair materials—dolomitic refractories, magnesia refractories, chrome; fuel—gaseous, fuel oil; construction materials—silica brick, basic brick, clay brick.

2-72. **Preparation of Raw Materials for Fast Melting in an Electric Arc Furnace.** Samuel D. Gladding. *American Iron and Steel Institute Advance Copy,* May 23, '46, 8 p.

Main requirements for efficient and economical operation of large basic arc furnaces. Electrode control; transformers; methods of charging; charging scrap; scrap preparation; drying raw materials; meltdown of oxidizers and fluxes.

2-73. **Canadian Copper Refiners Montreal East Plant.** J. H. Schlorn and E. M. Elkin. *Canadian Mining and Metallurgical Bulletin,* no. 408, April '46, p. 143-190.

Receiving and sampling departments; tank house; electrical circuits; production of starting sheets; cathodes; furnace department; silver refinery operations; slime digestion and roasting; Dore furnace; parting plant; selenium plant; copper sulphate plant; vacuum crystallization; acid recovery plant; power. Uses and applications of products of copper refining—copper, silver, gold, selenium, tellurium. 6 ref.

2-74. **The Electrowinning of Chromium From Trivalent Salt Solutions.** R. R. Lloyd, W. T. Rawles and R. G. Feeney. *Electrochemical Society Preprint* 89-20, April 15, '46, p. 233-244.

Process developed by U. S. Bureau of Mines; two methods for producing chromic sulphate electrolyte from domestic chromites; flow sheets for each process. 12 ref.

2-75. **The Swedish Acid Openhearth Process.** S. M. Wejle. *Metallurgia,* v. 33, April '46, p. 315-317.

The high quality of Swedish iron ore and the process of melting in the acid openhearth furnace to manufacture steel low in sulphur and phosphorus have built up a high reputation for Swedish steel. Reference is made to the initial use of a furnace built on the Siemens principle and employing an openhearth, and to some factors which contribute in the production of high-grade steel.

2-76. **Steelmaking Practice as It Affects Properties of Interest to the User.** *Industrial Heating,* v. 13, May '46, p. 808-812, 822.

Differences in practice developed over the last 20 years, with emphasis on the meeting of specifications involving the tensile strength of as-rolled steels and hardenability.

2-77. **Southwestern Section of Openhearth Conference Reviews Operating Problems. Part II.** *Industrial Heating,* v. 13, May '46, p. 814-820.

Metallurgical and operating problems and slag control.

2-78. **Hermann Göring Steelworks—Steelmaking Practice.** *British Steelmaker,* v. 12, May '46, p. 236-241, 245.

An exhaustive survey of the extensive properties of the Hermann Göring steelworks, covering iron ore mines, blast furnaces, steel melting plants, rolling mills, foundry, forging plants, and shell machining shops.

2-79. **Basic O-H Slags.** S. O. Agrell. *Iron and Steel,* v. 19, May 10, '46, p. 264-275.

Mineralogical observations on the principal phases. Constitution of a large number of slags studied by chemical and microscopical means. 29 ref.

2-80. **Ladle Reactions in Rimmed Steel.** Frank G. Norris and Edward B. Hughes. *Iron Age,* v. 157, June 6, '46, p. 72-76.

Discussion of ladle reactions in rimmed steel directed toward defining conditions which may prevent such reactions. Statistical approach. Interrelationship of such factors as FeO, carbon, final minus preliminary manganese, silicon additions and manganese drop during pouring operation.

2-81. **Zinc Ribbon—a Method of Production Direct From Ingot.** J. C. Phillips. *Metal Industry,* v. 68, May 17, '46, p. 392.

An apparatus for the spinning of zinc ribbon, from ingot zinc, for use in extractor boxes in the reduction works at Government Gold Mining Areas, Ltd., South Africa, is described (Condensed version of a paper presented to the Chemical, Metallurgical, and Mining Society of South Africa.)

2-82. **Boron-Treated Steels.** R. A. Grange and T. M. Garvey. *Steel,* v. 118, June 10, '46, p. 98, 100, 102, 104.

Factors affecting hardenability and related properties of boron-treated steels determined by selecting for study four commercial openhearth heats containing 0.40%, 0.52%, 0.63% and 0.75% carbon. In each case, a sample from an untreated ingot was compared with that from one or more adjacent ingots to which Grainal or Ferro-Boron had been added in the mold after the steel had been killed by aluminum. (Paper for American Society for Metals.)

2-83. **Aid to Control of Openhearth Practice by Statistical Methods.** R. E. Dienst. *Iron and Steel Engineer,* v. 23, May '46, p. 68-78.

Following questions summarize discussion: How would one determine the true tonnage capacity of a furnace on mixed types of steel? Does not the charge to tap fuel tell the efficiency of first helper, furnace, the burner and fuel? Are not additional data irrelevant? Statistics on the control of tramp elements (Cr, Mo, Cu, Sn) in steel are also of extreme importance and would benefit by discussion. What are the possibilities of personalizing the statistics further, to invite top effort by the first helper toward sound metallurgical practice?

2-84. **A.I.M.E.'s Openhearth and Blast Furnace Committees Discuss Postwar Production Problems.** Ralph W. Farley. *Metal Progress,* v. 49, June '46, p. 1188-1192.

Openhearth problems; acid openhearth operation; slag-metal reactions; quality of steel; furnace construction and maintenance; miscellaneous operating details; ore supplies.

2-85. **The Blast Furnace Process and Means of Control.** T. L. Joseph. *Blast Furnace and Steel Plant,* v. 34, June '46, p. 709-714.

Postwar shifts in emphasis; basic features of smelting process; arrangement of material in the furnace; patterns of gas distribution inherent to present raw materials and charging methods; greater permeability needed in area between walls and center; temperature variations in shaft influence hearth temperatures. (Henry Marion Howe Memorial Lecture for American Institute of Mining and Metallurgical Engineers.)

2-86. **Practical Interpretation of Theoretical Steelmaking for the Benefit of Management and Operator. Part II—Pouring and Solidification.** C. F. Christopher. *Blast Furnace and Steel Plant,* v. 34, June '46, p. 715-720.

Ladle temperature; stress formation and relief accompanying the solidification and heat treatment of steel; defectiveness caused by sinking of the head metal, primary piping, feeding lines, open shrinkage and internal cavities; defectiveness occurring in steel masses after the solidification period.

2-87. **Soaking Pit Operation, Part I.** D. M. McGeary and R. D. Hindson. *Blast Furnace and Steel Plant,* v. 34, June '46, p. 721-726.

History and development; present-day equipment; operation; metallurgical factors.

2-88. **Dead Banking of Blast Furnaces.** L. E. Riddle. *Blast Furnace and Steel Plant,* v. 34, June '46, p. 733-740.

There is a new and improved method of banking furnaces either for short or extended periods, known as "dead banking", that is now gaining acceptance among blast furnace operators.

2-89. **Carbon in Pig Iron.** Wilfred H. White. *Foundry,* v. 74, June '46, p. 109.

There is a definite relationship between silicon content and carbon content of all pig iron produced in the blast furnace. This is due to the fact that a condition of saturation exists, excess carbon being eliminated as "kish" during solidification and cooling. Manganese content between 1 and 3% appeared to have little or no bearing on this relationship. Upon plotting these points, only slight deviations were found from a straight line until the silicon content approached 13%, when an abrupt change in direction was observed.

2-90. **Magnesium Practice at I. G. Farben.** *Iron Age,* v. 157, June 27, '46, p. 68.

Condensation of a recent report of the Combined Intelligence Objectives Subcommittee which discusses developments in German magnesium production and fabrication. Total tonnage of magnesium produced in Germany was extracted by electrolytic processes, either the I. G. present process or the I. G. original process as used by Wintershalle at Herringen.

2-91. **Beryllium in Germany.** *Metal Industry,* v. 68, June 14, '46, p. 469-470.

Production of beryllia and the metal at the Degussa plants. (Extract from report for the British Intelligence Objectives Subcommittee by R. Potvin.)

2-92. **Use of Scrap in the Blast Furnace.** Kurt Neustaetter. *Steel,* v. 119, July 1, '46, p. 122, 136, 138, 140, 143, 144, 146.

Method of charging borings and turnings. Procedure for avoiding periodical upsets of furnace. Campaigns in which borings and turnings were put on and taken off furnace are analyzed.

2-93. **The Low-Temperature Gaseous Reduction of Magnetite Ore to Sponge Iron.** O. George Specht, Jr. and Carl A. Zapffe. *Metals Technology,* v. 13, June '46, T. P. 1960, 41 p.

Paper has three principal divisions: an exhaustive examination of all previous work on low-temperature gaseous reduction; experimentation on the reduction of a magnetite with hydrogen, and development of certain thermodynamic relationships in reduction, with a summarized depiction of the factors in the general process. 228 ref.

2-94. **A New Soaking Pit Design.** Norman J. Urquhart. *Iron and Steel Engineer,* v. 23, July '46, p. 101-102.

Design gives additional ingot capacity for a given area; increase in capacity is accomplished by eliminating regenerators and recuperators; efficiencies are said to be comparable.

2-95. **The Electric Furnace Melting of Copper.** R. H. Waddington and J. C. Bischoff. *Canadian Mining and Metallurgical Bulletin,* no. 409, May '46, p. 199-226.

Furnace shells; furnace roofs and electrodes; duct system and charge rack; launders and pour hearths; incoming power; transformers and electrode controls; induction units; control board; refractory brick lining of furnace; monolithic bottom; tap hole and launder construction; pour hearth lining; starting-up and operating procedure; temperature control; oxygen control; electrical operation; electrode replacement; cleaning charge slot; skimming; furnace bottom maintenance; other refractory maintenance; records; cathode quality.

2-96. **Experimental Electric Arc Furnace Smelting.** H. S. Newhall. *Metallurgia,* v. 34, June '46, p. 91-93.

Covers furnace design, choice of place, electrodes, refractories, sizing of charge components, and interpretation of experimental results. Considerable time and money can be saved by first running a series of small batch-type heats in a tilting furnace, in which the general metallurgical values are established. Running the smelting furnace itself over a 24-hr. period should be done only after the batch heats have determined the amounts of materials to be used.

2-97. **Speculations on Future Steelmaking.** *Steel,* v. 119, July 29, '46, p 94, 96.

Many direct-from-furnace-to-processing operations envisioned by a steelmaker may have tremendous cost-cutting and time-saving possibilities if realized in the steel plant of tomorrow.

2-98. **Dutch Aluminum Production.** *Metal Industry,* v. 69, July 12, '46. p. 33-34.

Operations during the war years of the plant of the Aluminium Wals-en-Persbedrijven N. V., Utrecht, Holland. (Abstract of report by British Intelligence Objectives Subcommittee.)

2-99. **A Statistical Method and Results of a Study of Factors Affecting Openhearth Production Rate.** A. P. Woods and C. R. Taylor. *Blast Furnace and Steel Plant,* v. 34, July '46, p. 847-854, 897, 901.

Results of tests made to analyze effect of variables on production rate and steel quality.

2-100. **The Blast Furnace Process and Means of Control. Part II.** T. L. Joseph. *Blast Furnace and Steel Plant,* v. 34, July '46, p. 855-860, 880-881.

Means for controlling gas flow; partially fluidized stock and channeling; peripheral distribution of the gas; will large furnaces solve existing problems?; inactive central core increases with hearth diameter; importance of blast temperature; potentialities of beneficiated raw materials.

2-101. **Soaking Pit Operation. Part II.** D. M. McGeary and R. D. Hindson. *Blast Furnace and Steel Plant,* v. 34, July '46, p. 861-865.

Discusses steps involved and a general outline of the operation of charging, heating, and fuel used.

2-102. **Electric Smelting.** Norman F. Dufty. *British Steelmaker,* v. 12, July '46, p. 342-344.

Prospects of really cheap power in Great Britain are much brighter now as the hydro-electric project in the Highlands approaches reality and the harnessing of the Severn Barrage remains a possibility. With provision of electric energy at competitive rates, production of ferroalloys and even pig iron in the electric furnace becomes an economic proposition.

2-103. **Openhearth Steelmaking Practice at Gusstahl-Fabrikation.** *British Steelmaker,* v. 12, July '46, 346-348.

A team of experts of the Combined Intelligence Objectives Subcommittee visited the works at Gusstahl-Fabrikationswerke, Bochum, and have issued a report on the openhearth practice carried out there, extracts from which are given.

2-104. **Beryllium.** Henry C. Kawecki. *Canadian Metals & Metallurgical Industries,* v. 9, July '46, p. 36, 38-39.

Applications; ore processes; reduction processes; direct production of beryllium copper. (Paper presented at 89th general meeting of the Electrochemical Society, April 1946.)

2-105. **Copper Production in Germany.** *Metal Industry,* v. 69, July 19, '46, p. 56-57.

Abstract of report by British Intelligence Objectives Subcommittee on metallurgical activities of the Nord Deutsche Affinerie.

2-106. **Ductile Titanium—II.** *Metal Industry,* v. 69, July 19, '46, p. 58.

Preparation by high-vacuum technique. Method is similar to that for tantalum and columbium. Preliminary work is encouraging. 2 ref.

2-107. **German Electrochemical Industry.** *Metal Industry,* v. 69, July 26, '46, p. 73-75.

Details of production processes at I. G. Farbenindustrie, Bitterfeld. Aluminum has been produced from clay using sulphuric acid as a first treatment, followed by alkali purification. It can be used if no bauxite is available, but is not as good a raw material. Magnesium has been produced with ferrosilicon and magnesium oxide in an experimental plant. Thus far it has not been promising. (Abstract of report for Combined Intelligence Objectives Subcommittee.)

2-108. **Nozzle and Stopper-Head Properties, Pouring Techniques, and Their Effect on Casting-Pit Performance.** L. G. Ekholm and L. D. Hower, Jr. *Electric Furnace Steel Proceedings A.I.M.E.*, v. 3, 1945, p. 49-75.

Finest quality steel can be quickly reduced to heavy melting scrap by improper teeming practice. Elimination of leaking streams through the attainment of perfect closures between the nozzle and stopper head. Effect of type of steel being melted on rate of erosion of nozzles and development of suitable refractories for the different steels. 50 figures. Discussion.

2-109. **Desulphurization in the Basic Arc Furnace.** H. C. Bigge. *Electric Furnace Steel Proceedings A.I.M.E.*, v. 3, 1945, p. 118-120; discussion, p. 121-124.

Preliminary data on the two-slag process, i.e., oxidizing and reducing period in a 7-ton basic arc 3-phase electric furnace, lined with magnesite brick, magnesite side walls, magnesite hearth and a sillimanite roof. Discussion of sulphur removal in the deoxidation period and effect of silicon on sulphur removal. Experimental results presented in graphical and tabular form.

2-110. **Bloom Formation of Iron and Steel and Its Relation to Capillarity and Diffusion.** E. Eyt. *Engineers' Digest*, v. 3, July '46, p. 346-348.

The conditions under which "bloom" is formed on the surface of molten iron and steel and its characteristics. Direct applications to temperature measurement, degree of oxidation, chemical composition, and the physico-chemical factors of diffusion, surface tension, and viscosity. (Abstracted from *Fondery*, no. 2, Feb. '46, p. 53-61.)

2-111. **Soaking Pit Operation. Part III.** D. J. McGeary and R. D. Hindson. *Blast Furnace and Steel Plant*, v. 34, Aug. '46, p. 986-989.

Practical rules which have been worked out through trial and error. Factors discussed are: heating rates; fuel consumption; maintenance; surface condition of steel at charge; thin-skinned ingots; burnt steel; overheating; phase changes; green steel; brittleness due to copper or tin; temperature.

2-112. **Practical Interpretation of Theoretical Steelmaking for the Benefit of Management and Operator. Part III.** C. F. Christopher. *Blast Furnace and Steel Plant*, v. 34, Aug. '46, p. 990-994.

Application of steelmaking to solidification and mold design.

2-113. **Quality Control in the Production of Basic Electric Furnace Aircraft and Bearing Steels.** W. J. Reagan. *Blast Furnace and Steel Plant*, v. 34, Aug. '46, p. 995-1001.

What is necessary to produce a consistent high quality aircraft or bearing quality material. Covers the charge; melting period; finishing period; pit practice; bearing quality steels 52100; silicon-chromium grade.

2-114. **Nickel Blast-Smelting Still Offers Advantages.** C. C. Downie. *Engineering and Mining Journal*, v. 147, Aug. '46, p. 88-90.

Describes operations at a nickel blast furnace smelter in Scotland for which several improvements in technology are claimed.

2-115. **Production of Alumina.** D. D. Howat. *Mine & Quarry Engineering,* v. 12, Aug. '46, p. 41-46.

Need for new developments and advances in Britain. Describes the Bayer process, the lime-soda sinter process, and the combination process. Economic analysis of the latter indicates that it should be considered for Britain.

2-116. **Beryllium Metal.** *Chemical Age,* v. 55, July 27, '46, p. 97-100.

German methods of manufacture; flow sheet.

2-117. **Light Alloys.** *Metal Industry,* v. 69, Aug. 23, '46, p. 154-156.

Notes on German production technique taken from a report by the Combined Intelligence Objectives Subcommittee investigating German industry.

2-118. **Production of Metals by Electrolytic Refining.** F. A. Forward. *Deco Trefoil,* July '46, p. 3-6.

Advantages of electrolytic methods; theoretical basis; electrorefining of copper, lead, nickel, silver, gold and other metals; electrowinning of zinc, copper, nickel, cadmium, aluminum, magnesium and precious metals.

2-119. **Openhearth Operations at Wickwire-Spencer Steel.** John B. Fleming. *Iron and Steel Engineer,* v. 23, Aug. '46, p. 79-81; discussion p. 81.

Improvements in openhearth practice in production of steel for wire. They include conversion from producer gas to oil, change in roof design, new temperature and flow controlling equipment and vacuum flue cleaning unit.

2-120. **The Boron-Oxygen Equilibrium in Liquid Iron.** Gerhard Derge. *Metals Technology,* v. 13, Aug. '46, T. P. 2004, 15 p.

Oxygen levels which can be attained in iron by iron borate slags, and the amounts of boron in iron at these oxygen levels were established. Includes experimental procedure and data. Results indicate that amounts of boron of commercial interest may be introduced into steel from boron oxides and that these amounts may be controlled by suitable oxygen control. 17 ref.

2-121. **An Experimental Enquiry Into the Interactions of Gases and Ore in the Blast Furnace. Part VI. Influence of Limestone on the Reduction of Iron Ore at up to 850° C.** H. L. Saunders and H. J. Tress. *Iron and Steel Institute Advance Copy,* July '46, 6 p.

Effect of limestone (and lime) on the reduction of iron ore by blast furnace gas examined under conditions where no interaction occurs between the solids. Temperature range covered is 450 to 850° C.; equilibrium conditions and reaction velocities are both studied.

2-122. **Random Notes on Chinese Steel Industry.** J. K. Stafford. *Metal Progress,* v. 50, Sept. '46, p. 470-473.

Blast furnace, openhearth and electric furnace capac-

ity; raw materials; transportation; steelmaking methods; laboratory facilities; production problems.

2-123. **Soaking Pit Crane.** John S. Morris. *Iron and Steel Engineer,* v. 23, Sept. '46, p. 102-105; discussion p. 105.

Can be used where limited head room and light runways do not permit the use of a conventional stiff leg crane.

2-124. **Blast Furnace Practice.** *Steel,* v. 119, Sept. 23, '46, p. 126-127.

Blast furnace operators, while greatly increasing capacity, also study innovations in practice. Blast conditioning found to result in higher output and lower coke consumption. Tests indicate operation of furnaces under higher top pressure metallurgically sound. Interest in carbon linings and insulation grows. Use of oxygen in blast is under study.

2-125. **Steelmaking Practice.** *Steel,* v. 119, Sept. 23, '46, p. 128-129.

Alloy contamination acknowledged as major problem by more than three-fourths of the steelmakers. Fifty-six per cent combat it with more rigid scrap inspection, 6% rely on improved melting practice, while 37% use both methods. Over 51% of openhearth shops make alloy steels and another 7% intend to do so. Linings get front-line attention.

2-126. **Practical Interpretation of Theoretical Steelmaking for the Benefit of Management and Operator. Part IV.** C. F. Christopher. *Blast Furnace and Steel Plant,* v. 34, Sept. '46, p. 1123-1128.

Stresses accompanying solidification which will lead to proper ingot mold design. Why ingot mold designers adhere to certain fundamental conditions in the designing of molds.

2-127. **Melting Rimmed Steel in the Electric Arc Furnace.** E. S. Kopecki. *Iron Age,* v. 158. Sept. 26, '46, p. 62-65.

Production of rimmed steel in the electric arc furnace, accomplished by the Steel Co. of Canada. Economical factors compare quite favorably with the openhearth, aided greatly by the low down-time of the electric furnace, as well as low cost of power furnished by Niagara Falls.

2-128. **Duplexing.** Norman F. Dufty. *Iron and Steel,* v. 19, Sept. '46, p. 513-515.

Advantages of the acid bessemer, basic openhearth process. 4 ref.

2-129. **Oxygen in Liquid Openhearth Steel—Oxygen Content During the Refining Period.** T. E. Brower and B. M. Larsen. *Metals Technology,* v. 13, Sept. '46, T.P. 2035, 15 p.

Study is made of oxygen content of a large number of liquid steels in the furnace and of activity of oxygen in the slag, when a steady state is approached.

2-130. **The Melting of Molybdenum in the Vacuum Arc.** Robert M. Parke and John L. Ham. *Metals Technology,* v. 13, Sept. '46, T.P. 2052, 12 p.

Methods for melting and casting molybdenum; special process needed to make molybdenum castings ductile; some of the properties of what may be regarded as a new, or at least modified form of the metal.

2-131. **Important Factors in Production of Acid Openhearth Steel. Part I.** B. B. Rosenbaum. *Industrial Heating,* v. 13, Sept. '46, p. 1470, 1472, 1474, 1476, 1478.

Standardization of charging practice; slag volume; control procedure.

2-132. **Effect of Impurities on the Electrodeposition of Manganese. (Concluded.)** David Schlain, John D. Prater, and Beatrice L. Lukens. *Mines Magazine,* v. 36, Sept. '46, p. 401-404, 420.

Effects of zinc, iron, arsenic, lead, vanadium, and dithionate ion investigated. Results tabulated and summarized.

2-133. **Killed Bessemer Steel for Seamless Tubes.** E. C. Wright. *Metal Progress,* v. 50, Oct. '46, p. 662-664.

A study of deoxidizing and steelmaking fundamentals led to the addition of molten pig iron to the converter as a means of obtaining the carbon deoxidation reaction and also of adding enough excess carbon for the desired final analysis. Steels made by this process are applicable to manufacture of seamless pipe and tubing in all sizes from ½ to 24 in. outside diameter.

2-134. **Important Factors in Production of Acid Openhearth Steel. Part II.** B. B. Rosenbaum. *Industrial Heating,* v. 13, Oct. '46, p. 1630, 1632, 1634.

Discussion of standardized charge practice continued along with practical operating problems, furnace practice versus castability and the use of graphite in acid openhearth charges.

2-135. **Mold Coatings.** C. R. Funk. *Blast Furnace and Steel Plant,* v. 34, Oct. '46, p. 1251-1256.

Comparative evaluation of the factors influencing the surface of alloy steel ingots given in chart. Factors which must be considered in selecting the proper coating material; some of the problems encountered, as well as characteristics of the various materials.

2-136. **Dry-Hot Cleaning of Blast Furnace Gas—a Revolution in Gas Cleaning.** F. E. Kling. *Blast Furnace and Steel Plant,* v. 34, Oct. '46, p. 1257-1264.

Description of apparatus for cleaning gas without the use of water. Describes and illustrates development of filter made of asbestos and glass fiber, and cites its advantages over a modern washer with an electric precipitator.

2-137. **The Effects of Variations in Raw Materials on Basic Openhearth Operations and Production.** Charles R. Fondersmith. *Blast Furnace and Steel Plant,* v. 34, Oct. '46, p. 1277-1283.

Considers the following raw materials: pig iron—cold and hot metal; scrap—domestic and outside purchases; ore—lump, briquetted, soft, sintered, nodulized; limestone and burned lime; fluorspar; fettling and bottom-making refractories—dolomite, magnesite and chrome; brick—silica, basic, clay; fuel—driven and gaseous. Metallic components and oxidizing elements discussed. (To be continued.)

2-138. **Nickel and Chromium Steels.** T. F. Baily. *Iron and Steel,* v. 19, Oct. '46, p. 561-563.

Experiments in electric smelting of Cuban ores.

2-139. **The Chromium-Oxygen Equilibrium in Liquid Iron.** Hsin-Min Chen and John Chipman. *American Society for Metals Preprint,* no. 7, 1946, 45 p.

Experiments are described in which liquid iron-chromium alloys containing up to 20% chromium were brought into equilibrium with accurately controlled gaseous mixtures of water vapor and hydrogen. Relationship between the ratio $(H_2O)/(H_2)$ and equilibrium chromium content of the bath was used to determine equilibrium constants and free energy changes in the reactions. Reactions were studied in crucibles of chromite and of chromic oxide and a method developed for manufacture of the latter.

2-140. **Boiling of the Liquid Metal in Steel Melting Furnaces.** V. S. Kotsho. *The Engineers' Digest,* v. 3, Oct. '46, p. 495-497.

Boiling is said to have an important influence upon the steelmaking process by equalizing temperature and composition of the melt and promoting heating and accelerating the reactions which take place. A mathematical analysis of the work involved in the boiling process is presented. First calculates energy absorbed by the metal from a single gas bubble rising through the melt, then extends the analysis to the work performed by all the gas bubbles present. Value obtained by application to an example is only about one-tenth that obtained from a formula worked out by H. Schenk in 1936. Author gives reasons why Schenk's calculations are thought to be incorrect. (From *Stal,* no. 2-3, 1945, p. 55-60.)

2-141. **Pilot-Plant Investigations of Matte Smelting of Chamberlain, S. Dak., Manganese Ore.** D. R. Torgenson, T. E. Evans, J. L. Morning, F. W. Wessel, and R. F. Knickerbocker. *Bureau of Mines Report of Investigations* 3917, Sept. '46, 47 p.

Smelting program on manganosiderite nodules. Initial step is the sulphidization of the beneficiated ore with FeS to form a matte This is followed by a smelting operation in which carbon and MnO or Mn_2O_3 are added to reduce the iron to the metallic state, so that it can be readily removed. The experimental work consisted of a study of the variables of the process on both a laboratory and pilot-plant scale. Specific recommendations and cost data are given for erection of a commercial plant. 25 ref.

2-142. **Pilot-Plant Production of Electrolytic Manganese From Manganese Ores From Metals Reserve Stock Piles at Deming, N. Mex., Cushman, Ark., and Phillipsburg, Mont.** J. H. Jacobs and H. C Fuller. *Bureau of Mines Report of Investigations* 3931, Sept. '46, 19 p.

Electrolytic manganese was made successfully from each of these ores by the standard methods of roasting, leaching, purification and electrolysis.

2-143. **The Side-Blow Converter in the Postwar Period.** A. W. Gregg. *Foundry,* v. 74, Nov. '46, p. 74-76, 158, 161.

Advantages of this type of equipment. Research at Battelle Memorial Institute prior to the war showed that the quality of steel from the converter was as good as that made in the openhearth, the electric furnace, and others. Summarizes possibilities for the postwar period.

2-144. **Producing Zirconium and Titanium in Germany.** Roger Potvin and G. S. Farnham. *Canadian Mining and Metallurgical Bulletin,* no. 414, Oct. '46, p. 516-524.

Procedure and special equipment used for commercial production of these rare metals in Germany during the war.

2-145. **The Chloride Process for Production of Beryllium in Germany.** Roger Potvin and G. S. Farnham. *Canadian Mining and Metallurgical Bulletin,* no. 414, Oct. '46, p. 525-537; discussion p. 527-538.

Advances made in Germany during the war show how technical beryllium oxide was prepared from the beryl ore; how this oxide was used as a high-grade refractory, especially for making high-temperature crucibles; how it was further processed into beryllium chloride; how, by a novel method, this beryllium chloride was freed from most of its impurities; and, finally, how it was reduced to the metallic state by electrolysis. A description is given of the procedure and equipment used in melting and casting the metal. The fabrication of beryllium X-ray windows is also mentioned.

2-146. **Oxygen Reduces Melting Time of Openhearth Heats.** *Steel,* v. 119, Nov. 11, '46, p. 178, 180.

Basic steelmakers using this gas experimentally report fuel savings, increased life of furnace and elimination of foam on high-scrap heats. Practice calls for faster charging time, modernization of scrap handling facilities and new type recording instruments. Report on hot metal quality questionnaire analyzed.

2-147. **Oxygen in Liquid Openhearth Steel—Effect of Special Additions, Stirring Methods and Tapping.** T. E. Brower and B. M. Larsen. *Metals Technology,* v. 13, Oct. '46, T. P. 2076, 11 p.

Average changes in excess oxygen beyond what would be in equilibrium with carbon then present if the pressure of carbon monoxide were 1 atm., following addition of spiegel or crop ends, or after procedures to promote stirring, or by tapping of the steel from the furnace. Observations show the consistency obtainable under the limitations imposed by practical operation.

2-148. **Production of Low-Sulphur Sponge Iron.** R. C. Buehl, E. P. Shoub. and J. P. Riott. *Metals Technology,* v. 13, Oct. '46, T P. 2093, 10 p.

New features of the Bureau of Mines process—that is, means for controlling the sulphur content of the sponge iron. Sized dolomite is the sulphur-controlling agent.

2-149. **An Electrochemical Study of the Properties of Molten Slags of the Systems CaO-SiO_2 and CaO-Al_2O_3-SiO_2.** Lo Ching Chang and Gerhard Derge. *Metals Technology,* v. 13, Oct. '46, T. P. 2101, 27 p.

Apparatus and method for studying the properties of molten slags by means of reversible cell measurements. Various electrode pairs have been tried. The silicon carbide-graphite pair seems to yield the best results. Different possible cell reactions are discussed. A suggested cell reaction which agrees with theoretical calculations is

given. Effect of composition and temperature on the cell electromotive force is extensively investigated. Some of the thermodynamic properties are also calculated.

2-150. **Steelmaking Practice as It Affects Properties of Interest to the User.** Charles H. Herty, Jr. *Metal Progress,* v. 50, Nov. '46, p. 809-814, 826.

Most important steelmaking practices which are necessary to fulfill physical requirements are composition control, slag control, deoxidation, and rolling mill operations. Discusses tensile properties and response to heat treatment. Some wartime problems were iron ore in the openhearth, aluminum, manganese, and alloys recovered from scrap.

2-151. **Preparation of Raw Materials for Fast Melting in an Electric Arc Furnace.** Samuel D. Gladding. *Blast Furnace and Steel Plant,* v. 34, p. 1404-1407.

Transformers; methods of charging; charging scrap; scrap preparation; drying raw materials; melt-down of oxidizers and fluxes.

2-152. **Fuel Utilization in Iron and Steel Works.** N. H. Turner and F. A Gray. *Blast Furnace and Steel Plant,* v. 34, Nov. '46, p. 1408-1412, 1424, 1426.

Utilization of blast-furnace gas; effect of irregular working of the blast furnaces and of future developments in blast-furnace practice; effect of cleanliness of blast-furnace gas; gas control; application of by-product gases; heat conservation.

2-153. **Use of Oxygen in Furnaces May Revolutionize Steelmaking.** W. A. Lloyd. *Iron Age,* v. 158, Nov. 21, '46, p. 104-105.

Future prospects for the process, in view of experimental work being conducted by several major U. S. and Canadian steel companies, the original Belgian work, and four years of tests by the Russians, 1932 to 1936.

2-154. **Chemical and Electrochemical Methods in Nonferrous Metallurgy.** V. V. Steuder. *Journal of Applied Chemistry* (U.S.S.R.), v. 19, no. 3, '46, p. 231-241. (In Russian.)

Description of long-term research project set up in the eastern part of the U. S. S. R. for the purpose of developing new methods for production of highly critical metals. This research covered the hydroelectric metallurgy of lead and antimony, the hydrometallurgy of cobalt and vanadium, electrolytic refining of nonferrous metals, application of waste sulphuric gas in hydroelectric copper production, and the investigation of electroconductivity of compounded technical electrolytes.

2-155. **Some Factors in the Reduction of the Iron Content of Magnesium-Base Alloys.** F. A. Fox, C. J. Bushrod, S. E. Mayer. *Journal of the Institute of Metals,* v. 73, Oct. '46, p. 55-82.

Investigations were carried out to establish a procedure, applicable to large-scale production, by which various magnesium alloys could, if desired, be made consistently with iron contents of the order of 0.002%. Settling experiments to determine possible mechanisms for the iron removal process are described in two sections. Section I deals with those on a small and medium laboratory

scale, being primarily of exploratory and theoretical interest, and section II with those on a full-production scale, in which the results of the smaller scale investigations were applied.

2-156. **Oxygen in Steelmaking.** E. S. Kopecki. *Iron Age,* v. 158, Nov. 28, '46, p. 47-50.

Some of the factors leading to the development of low-cost oxygen. Experimental openhearth heats using oxygen suggest the possibility of considerable reduction in processing time.

2-157. **A New Addition Agent for the Electrolytic Refining of Tin and Lead.** Frank C. Mathers and Maurice M. Felger. *Electrochemical Society Preprint* 90-28, Oct. '46, 4 p.

"Hexanol-3 tails", phenol coefficient 16, found to be an excellent addition agent for the electrolytic refining of tin from a stannous sulphate-sulphuric acid electrolyte, 1.93 lb. being required per ton of tin refined. In the electrolytic refining of lead from the fluosilicate bath, 0.8 lb. is required per ton of metal refined.

2-158. **Beryllium—I.** *Metal Industry,* v. 69, Nov. 8, '46, p. 384, 394.

Production, and use in aluminum and magnesium alloys. Fluoride process; chloride process.

2-159. **Use of Oxygen in the Openhearth.** G. V. Slottmann and F. G. Kerry. *Steel,* v. 119, Dec. 2, '46, p. 106-108, 149-150, 152.

Possibilities of increasing production by firing oxygen with the regular fuel during meltdown period. Large-scale applications of this new process are being made to prove its economic value. Some theoretical considerations.

2-160. **Production of Low-Silicon Basic Iron Using High-Magnesia Slags.** M. E. Nickel. *Steel,* v. 119, Dec. 9, '46, p. 112-114, 158.

Experimental program conducted at Chicago stack operating with slags of high magnesia content gives promise of smelting iron low in silicon and sulphur and with a high physical temperature.

2-161. **Calcium Hydride.** E. E. Halls. *Industrial Chemist,* v. 22, Nov. '46, p. 680-685.

Its preparation and industrial applications, especially as a reducing agent for production of high purity metals from oxides such as those of chromium, thorium, beryllium, vanadium, zirconium, molybdenum, boron. 18 ref.

2-162. **The Structure and Mineralogy of Blast Furnace Slags. Part I.** D. G. Runner. *Pit and Quarry,* v. 39, Dec. '46, p. 73-74, 83.

Illustrated article begins description. (To be concluded.)

2-163. **Vacuum Melting in Germany.** George T. Motock. *Iron Age,* v. 158, Dec. 12, '46, p. 64-69.

Describes plant of Heraeus Vacuum-schmelz of Hanau, Germany, the only large plant devoted exclusively to melting and pouring alloys in vacuum.

2-164. **The Melting Shop of the Turkish State Iron and Steel Works, Karabuk.** L. Cook. *Iron and Steel Institute Advance Copy,* 1946, 11 p.

Details of the furnaces and materials used together with descriptions of steelmaking and casting practice for the production of ingots designed for rolling in the mill without preliminary reduction in a cogging mill. Summaries of performance figures included. Brief account of controls and of methods used for training personnel.

2-165. **Basic Steelmaking.** K. Balajiva, A. G. Quarrell and P. Vajragupta. *Iron and Steel,* v. 19, Nov. 21, '46, p. 645-653.

Apparatus and experimental procedure used in laboratory investigation of the phosphorus reaction; analytical procedure; application of the technique to the phosphorus reaction in the basic steelmaking process; range of slag and metal compositions employed; experimental results; treatment of results; slag constitution; statistical treatment of the analytical results in the light of the probable slag constitution at high temperatures. 22 ref.

2-166. **Interactions of Gases and Ore. Part VI.** H. L. Saunders and H. J. Tress. *Iron and Steel,* v. 19, Nov. 21, '46, p. 714-716.

Influence of limestone on the reduction in the blast furnace of iron ore up to 850° C.

SECTION III

PROPERTIES OF METALS AND ALLOYS

3-1. **German Stainless Steels.** Alexander L. Feild. *Iron Age,* v. 156, Dec. 20, '45, pp. 60-67.

Data on properties, applications and methods of processing and heat treating various types of stainless steels and high temperature alloys commercially produced in Germany during war.

3-2. **Alclad 75S.** M. Raskin. *Metal Industry,* v. 67, Nov. 30, '45, pp. 358-361.

Investigation of physical properties and formability.

3-3. **Properties of High Temperature Alloy Steels.** C. I. Wolfson and M. P. Mjakov. *Engineers' Digest (American Edition),* v. 2, Nov. '45, pp. 545-547.

Investigations into suitability of alloy steels as bolting material; structural steels and tool steels examined. Tabulation of steels investigated, their composition, heat treatment, and mechanical properties. (From *Stal,* no. 3-4, 1943, pp. 42-47.)

3-4. **The Reaction of an Aluminum-Magnesium Alloy With Water Vapor, and the Absorption of Hydrogen.** R. Eborall and C. E. Ransley. *Journal of the Institute of Metals,* v. 71, Oct. '45, pp. 525-552.

Reactions involved in blistering of aluminum-magnesium alloys studied. Method described for estimation of the gas contents of these and other alloys, and experiments made on the solution and diffusion of hydrogen and the reaction of the alloys with water vapor. 17 ref.

3-5. **Alclad 75S.** M. Raskin. *Metal Industry,* v. 67, Dec. 7, '45, pp. 381-383.

Investigation of physical properties and formability.

3-6. **Cerium in Light-Alloy Technology.** *Light Metals,* v. 8, Dec. '45, pp. 630-631.

Evidence indicates that additions of cerium from 0.2% to 0.5% to aluminum and to magnesium alloys result in specific benefits—namely, improved grain structure, higher tensile strength, greater elongation, augmented hardness, improved creep resistance, better fatigue and thermal resistance, facilitated castability, less liability to cracking, and superior thermal properties. 37 ref.

3-7. **Magnesium Casting Alloys.** L. W. Eastwood, James A. Davis and James DeHaven. *American Foundryman,* v. 8, Dec. '45, pp. 54-68.

Two European casting alloys, A-8 and AZ-91, have been compared in considerable detail with the two American alloys, ASTM-4 and ASTM-17. Mechanical properties of A-8 and ASTM-4 are comparable, while those of AZ-91 and ASTM-17 are also comparable. Mechanical property comparisons were made on test bars which had been ideally heat treated to produce practically complete solution with only a trace or less of burning. There is some indication that with these ideally heat treated materials, ASTM-17 is slightly superior to the others in the heat treated and aged condition.

3-8. **Alclad 75S.** M. Raskin. *Metal Industry,* v. 67, Dec. 14, '45, pp 402-404.

Investigation of physical properties and formability.

3-9. **Alclad 75S.** M. Raskin. *Metal Industry,* v. 67, Dec. 21, '45, pp. 422-426.

Discusses hot and cold dimpling, citing advantages of former. Gives operation of resistance dimple.

3-10. **Stainless Steels—Physical Properties and Mechanical Characteristics.** *Western Metals,* v. 3, Dec. '45, pp. 50-51.

Table covers hardenable chromium, non-hardenable chromium, austenitic chromium-nickel.

3-11. **What to Expect of High Strength Aluminum Alloys.** Roy A. Miller and Max E. Tatman. *Automotive & Aviation Industries,* v. 93, Dec. 15, '45, pp. 18-21, 85-86, 88.

Five high strength aluminum base alloys discussed. Copper group includes T8 tempers of Alcoa's 24S alloy, R301 alloy made by Reynolds Metals Co., and Alclad 14S made by Aluminum Co. of America. Zinc group consists of Alcoa's 25S alloy and Reynolds' R303 alloy. Characteristics listed in tables compared and evaluated.

3-12. **Aluminum Alloys and Their Applications.** *Light Metal Age,* v. 3, Dec. '45, pp. 8-14, 32.

Properties and applications of commercial wrought aluminum alloys with special reference to their advantages in structural engineering; tensile properties, moduli of elasticity and resilience, and strength-weight comparisons; resistance to corrosion, appearance, fabricating characteristics, and electrical conductivity. Reveals the unusual range and versatility of the materials and indicates a rapid extension of their applications.

3-13. **Rare Metals as Constituents in Light Alloys.** W. J. Kroll. *Light Metal Age,* v. 3, Dec. '45, pp. 23-30.

Effects of additions of rare metals to aluminum and magnesium alloys; value and direction of further experiments with such additions; factors affecting the availability of rare metals, such as occurrence of the ores, market demands, and methods of extraction; methods of introducing the rare metals into light alloys; bibliography.

3-14. **Oxidation of Light Metals.** L. de Brouckere. *Light Metal Age,* v. 3, Dec. '45, pp. 35-36, 46.

Samples of both commercial and high purity aluminum, magnesium, and aluminum alloys containing from 2.5 to

8% magnesium have been examined by electron diffraction after oxidation *(a)* at room temperature, *(b)* at temperatures up to the melting point, and *(c)* after melting. Conclusions given as to the character of the oxide film on these materials after various treatments. 27 ref. (Abstract from paper for Institute of Metals.)

3-15. **Cast Steels—Vanadium, Copper and Silicon Alloy Types. (Materials Work Sheet.)** *Machine Design,* v. 18, Jan. '46, pp. 153-158.

Gives properties prescribed in ASTM specifications; characteristics; applications; fabrication; heat treatments; resistance to corrosion; material specifications.

3-16. **Ductile Permanent Magnets Offer New Design Possibilities.** J. H. Goss. *Product Engineering,* v. 17, Jan. '46, pp. 44-47.

Properties of some ductile materials; magnetic properties of magnet materials compared; factors to be considered in magnet design explained with the aid of curves of the magnetic properties. Photographs show magnet parts and several novel mechanisms that have been fabricated from the ductile materials.

3-17. **Nickel-Iron Alloys for Magnetic Circuits.** Laurence C. Hicks. *Electrical Manufacturing,* v. 37, Jan. '46, pp. 114-116, 206, 208.

With the addition of small percentages of other metals and with variation in the nickel-iron ratio, a diversity in magnetic properties, in resistivity and other physical characteristics is obtained.

3-18. **Residual Elements and Gas Contents of Cast Iron.** J. E. Hurst. *Foundry Trade Journal,* v. 77, Dec. 27, '45 p. 363-369.

The fundamental role played by small amounts of rare elements in the properties of alloys.

3-19. **Alclad 75S.** M. Raskin. *Metal Industry,* v. 67, Dec. 28, '45, p. 440-441.

Machinability; welding.

3-20. **Zirconium Metal, Its Manufacture, Fabrication and Properties.** Donald B. Alnutt and Charles L. Scheer. *Electrochemical Society Preprint* 88-30, 1945, p. 357-366.

Major improvements in processes for purifying zirconium metal are traced down to the present methods which produce both powdered and massive metal of high purity.

3-21. **Phosphorus-Bronze.** K. Winterton. *Metal Industry,* v. 68, Jan. 11, '46, p. 23-26.

Tensile properties, hardness and density of chill-cast phosphorus-tin bronzes prepared by the flux-degassing process and slowly poured. Microstructures of these alloys have been examined, and the relations between constitution and mechanical properties discussed. 4 ref.

3-22. **Cold Heading Die Steel.** A. S. Jameson. *Steel,* v. 118, Jan. 21, '46, p. 82-85, 123-124, 126.

Intimate relationship between hardenability and austenitic grain size should be considered carefully in selecting die steels. Various steel analyses discussed. 10 ref.

3-23. **The Column Strength of Aluminum Alloy 75S-T Extruded Shapes.** Marshall Holt and J. R. Leary. *National*

Advisory Committee for Aeronautics, Technical Note 1004, 1946, 15 p.

The object of this investigation was to determine the curve of column strength for extruded aluminum alloy 75S-T. In addition to three extruded shapes, a rolled and drawn round rod was included. Specimens of various lengths covering the range of effective slenderness ratios up to about 100 were tested. 2 ref.

3-24. **German Vs. American Cemented Carbides.** Philip M. McKenna. *Iron Age,* v. 157, Feb. 7, '46, p. 64-68.

Tables give comparative microstructures and physical properties of the German and American cemented carbides.

3-25. **Some High Nickel Alloy Irons.** F. G. Sefing. *Product Engineering,* v. 17, Feb. '46, p. 92-96.

Industrial uses of seven types of high nickel and nickel-copper alloys, known as Ni-Resist, are discussed. Chemical, physical and mechanical properties of the alloys are presented and compared. Photomicrographs of the metal structure and curves showing the coefficients of expansion are included.

3-26. **A Workable Classification of Toolsteels.** C. L. Hibert. *Metal Progress,* v. 49, Feb. '46, p. 333-341.

Simple mark-and-number codes replace trade names in tool design, heat treating and purchasing departments as well as in tool room. Since adoption of new coding system tool breakage has been reduced, man-hours of highly skilled labor have been saved in the tool room, and production has been increased.

3-27. **Melting Points of Metals and Alloys.** *Oxy-Acetylene Tips,* v. 15, Jan. '46, p. 12-13.

Chart gives melting point, melting point range, and color scale.

3-28. **Mild Steel and Its Properties, With Special Reference to Its Working and Age-Hardening.** C. A. Edwards. *Foundry Trade Journal,* v. 78, Jan. 24, '46, p. 83-86, 82.

New characteristics; stretcher strains; aging. (Lecture given at the annual meeting of the Institute of Vitreous Enamelers in England.)

3-29. **Heat and Corrosion Resistant Cast Steels.** *Machine Design,* v. 18, Feb. '46, p. 151-156.

Properties prescribed in A.S.T.M. specifications; characteristics; applications; corrosion resistance; heat treatments.

3-30. **Graphitization of Carbon-Molybdenum Steel in High-Temperature Steam Piping.** George A. Timmons. *Welding Journal,* v. 25, Jan. '46, p. 1s-6s.

Problem of graphitization of carbon-molybdenum steel in service in high temperature steam plants considered from the viewpoints of thermodynamic stability and rates of reaction. Some facts about the role of molybdenum in carbon-molybdenum steel presented. Proposed that carbon-molybdenum steels containing not over 0.06% carbon be investigated with regard to their use for high-temperature steam piping. 6 ref.

3-31. **The Behavior of Hydrogen in Steel During Pickling.** Carl A. Zapffe. *Wire and Wire Products,* v. 21, Feb. '46, p. 149-157.

Passage of hydrogen in and out of the metal; factor of gas pressure; blisters from hydrogen in macroscopic voids; embrittlement from hydrogen in microscopic voids, a definition of hydrogen embrittlement; amount of hydrogen that wire may absorb during pickling; progression of embrittlement; other noteworthy effects of hydrogen embrittlement. 46 ref.

3-32. **Stainless "W"—a Precipitation Hardening Stainless Steel of the 18% Chromium, 8% Nickel Type.** *Wire and Wire Products,* v. 21, Feb. '46, p. 168, 186-187.

Stainless "W" can be rolled into billets, bars, sheets or shapes, drawn into wire or pierced for tubing, or it may be forged as desired into any shape or size, the finished product being amenable to heat treatment to develop the desired hardness in addition to corrosion resistance superior to that of the heat treatable straight chromium steels and approximately the same as that of 18-8 stainless steels in most corrosive media.

3-33. **Which Aluminum Alloy for Your Product? Part II.** James L. Erickson. *Die Casting,* v. 4, Feb. '46, p. 32-35.

Characteristics and properties of these alloys.

3-34. **Impurities in Copper—I.** *Metal Industry,* v. 68, Feb. 1, '46, p. 93-94.

Preparation of super-pure metal. 2 ref.

3-35. **Effect of Alloying Elements on Mechanical Properties.** Maxwell Gensamer. *Iron Age,* v. 157, Feb. 14, '46, p. 66-70.

Attention concentrated on problem of trying to understand quantitatively how alloying elements in solid solution, and undissolved compounds distributed in these solid solutions, affect mechanical properties. (Abstract of Campbell Memorial Lecture.)

3-36. **Metal Coated Plastics.** *Steel,* v. 118, Feb. 18, '46, p. 92-95, 136, 138.

Plated plastics, already established, may find many uses in both decorative and engineering applications. Physical property and other data provide basis for properly evaluating their possible usefulness.

3-37. **Some Interesting Properties of Titanium Steels.** George F. Comstock. *Journal of the American Ceramic Society,* v. 29, Jan. 1, '46, p. 1-7.

Steel containing sufficient titanium to combine with all the carbon does not react with vitreous enamels like ordinary low carbon steel or ingot iron so that white cover-coat enamels, without a ground coat, can be fused on it without blistering or black specking. Titanium content must be more than 4.5 times the carbon content. It is of excellent quality for deep drawing and does not have a definite yield point even when normalized or annealed so that stretcher strains cannot occur in it. Is resistant to caustic embrittlement, to attack by hydrogen at high temperatures and pressures, also resists sagging at enameling temperatures better than regular enameling steel or iron.

3-38. **Heat Resisting Steels.** L. F. Keeley. *Industrial Chemist,* v. 22, Jan. '46, p. 40-41.

Choice of heat resisting compositions; table gives typical specifications of some heat resisting steels. (Paper for Institution of Chemical Engineers, Northwestern branch, Manchester, England.)

3-39. **There Is a Difference in Metallurgy. Part I.** Victor E. DeStrasser. *Industry and Welding,* v. 19, Feb. '46, p. 47-50.

Discusses arc welding and steelmaking methods and their effects on properties.

3-40. **Physical Properties of Copper-Manganese-Zinc Alloys Containing 60% Copper and 5 to 25% Manganese.** R. S. Dean, J. R. Long, T. R. Graham, and R. G. Feustel. *Metals Technology,* v. 13, Jan. '46, T. P. 1956, 12 p.

Composition and fabrication of alloys; the quasi-binary system at 60% copper; physical properties of annealed material; effect of cold working; effect of annealing temperature on properties of cold worked alloys. 8 ref.

3-41. **The Electrical Resistance of Iron Wires and Permalloy Strips at Radio Frequencies.** Alva W. Smith, J. H. Gregory and J. T. Lynn. *Journal of Applied Physics,* v. 17, Jan. '46, p. 33-36.

Ratio of a.c. to d.c. resistances of iron wires and permalloy strips has been measured in frequency range 1.5 to 6.0 megacycles per sec. Empirical equations obtained are compared with existing theoretical equations derived on assumption of constant permeability.

3-42. **New Age-Hardening Stainless Steel Provides Strength Without Cold Working.** T. C. Du Mond. *Materials and Methods,* v. 23, Feb. '46, p. 432-433.

Stainless "W" meets need for steel which has strength, hardness, and corrosion resistance and which can be fabricated by all ordinary methods.

3-43. **Tool Steels Classified.** Howard J. Wright. *Canadian Metals and Metallurgical Industries,* v. 9, Feb. '46, p. 20-23, 28.

Tool steels are classified in three sections and nine groups; their characteristics, type analysis and heat treatment are shown on a comprehensive chart. Each section and group is described in detail and all tool steels sold in Canada are grouped in a reference chart.

3-44. **Sulphur.** E. S. Brown. *Iron and Steel,* v. 19, Feb. '46, p. 71-74.

Effects in cast iron and steel. (Digest of lecture given to Sheffield Trades Technical Societies.) 4 ref.

3-45. **Susceptibility of Four Magnesium Casting Alloys to Microporosity and Its Effect on the Mechanical Properties.** Jay R. Burns. *Metals Technology,* v. 13, Feb. '46, T.P. 1955, 18 p.

Decrease of mechanical properties caused by any given amount of microporosity is measured for H, C, A8, and AZ_{81} alloys. The relative susceptibility of each of the four alloys to microporosity is also determined. Mechanical properties and nominal chemical analyses given in table. 6 ref.

3-46. **Vicalloy—a Workable Alloy for Permanent Magnets.** E. A. Nesbitt. *Metals Technology,* v. 13, Feb. '46, T.P. 1973, 11 p.

Describes a permanent-magnet material that can be machined as cast, and when handled with some care can be rolled to thin sheet and drawn to fine wire. Optimum magnetic properties are developed by a simple heat treatment. Composition is 38.5% iron, 52% cobalt, 9.5% vanadium. A similar composition cold worked to 75 to 95% reductions is substantially improved in energy product. Commercial use of Vicalloy is made in tape for speech recording. 8 ref.

3-47. **High Strength Aluminum Alloys.** R. A. Miller and M. E. Tatman. *Metal Industry,* v. 68, Feb. 22, '46, p. 152-154.

In cases where design dictates use of precipitation hardening aluminum alloys, the detail parts should be formed, whenever practicable, in the as-quenched, solution heat treated condition; the high strength aluminum alloys should not be joggled, dimpled, formed or reworked when in the precipitation hardened condition unless accurately controlled "heated-tool" methods are used.

3-48. **Notes on the Influence of Austenitic Grain Size Upon the Mechanical, Physical, and Technical Properties of Carbon Steel.** G. Delbart and R. Potaszkim. *Engineers' Digest (American Edition),* v. 3, Feb. '46, p. 81-83.

Effect of austenitic grain size on several properties of steel, including hardness, impact resistance, transformation points, forgeability, and creep resistance. (Abstract from *Revue de Metallurgie,* v. 41, '44, no. 4, p. 97-110; no. 5, p. 143-149.)

3-49. **Impurities in Copper—III.** *Metal Industry,* v. 68, March 1, '46, p. 173.

Cold work and density; solubility of tellurium. Effect of cold work; recrystallization temperature.

3-50. **Which Copper-Base Alloy for Your Product? Part I.** James L. Erickson. *Die Casting,* v. 4, March '46, p. 28-30, 32.

Reviews various alloys suitable for die castings with special reference to the physical, mechanical, and chemical properties of the various copper-base alloys.

3-51. **Stainless "W"—a Precipitation Hardening Steel of the 18-8 Type.** *Western Metals,* v. 4, Feb. '46, p. 28.

Basic composition is so balanced as to insure, without the necessity of cold working, approximate completion of the austenite-to-ferrite (martensite) transformation and the subsequent process of precipitation hardening. Most important element is titanium.

3-52. **Why Tool Steels Do Not Act Alike.** S. C. Spalding. *American Machinist,* v. 90, March 14, '46, p. 107-112.

General classification of toolsteels into five groups amplified by discussion of effects of individual elements on constitution, hardenability, and other properties.

3-53. **Standard Alloy Designations for Heat and Corrosion Resistant Castings.** *Materials and Methods,* v. 23, March '46, p. 765.

Table gives percentage of nickel, chromium, carbon, and other elements.

3-54. **Properties of Steels for High-Temperature Service.** *Materials and Methods,* v. 23, March '46, p. 769, 771.

Table I lists composition and room temperature physical properties of steels used in high temperature service; Table II gives variation in physical properties with temperature for steels listed in Table I.

3-55. **Silicon-Impregnated Steels.** Harry K. Ihrig. *Iron Age,* v. 157, April 4, '46, p. 73-78.

Equipment, technique and materials to be used for optimum results.

3-56. **Which Copper-Base Alloy for Your Product? Part II.** James Erickson. *Die Casting,* v. 4, April, '46, p. 27-28, 30, 51-53.

Various alloys suitable for die castings with special reference to the physical, mechanical, and chemical properties of the various copper-base alloys.

3-57. **Before Specifying Magnesium Study the Processing Techniques.** N. H. Simpson. *Electrical Manufacturing,* v. 37, April '46, p. 135-137, 204, 206, 208, 210.

Characteristics peculiar to magnesium and its alloys. Techniques for avoiding corrosion and other difficulties are discussed.

3-58. **Strength and Ductility.** Maxwell Gensamer. *Metal Progress,* v. 49, April '46, p. 731-734.

Relationships among the measured mechanical properties of metals and their mechanical behavior in service, and how they are controlled by chemical composition and structure. How alloying elements in solid solution and undissolved compounds distributed in these solid solutions affect, quantitatively, the mechanical properties of steels. (Abstract of A.S.M. Campbell Memorial Lecture.)

3-59. **Industrial Significance of the Basic Characteristics of Magnesium.** J. D. Hanawalt. *Metal Progress,* v. 49, April '46, p. 739-743.

Points out how, because of its lightness, magnesium may be used to improve design. Some misconceptions cleared away. A picture of serviceability presented in terms of actual experience. A valuable service property of magnesium is its superior resilience.

3-60. **Introducing Stainless W—a New Product.** Raymond Smith, E. H. Wyche and W. W. Gorr. *Railway Age,* v. 120, March 30, '46, p. 678-680.

Composition, heat treatment, microstructure, physical and mechanical properties of a precipitation hardening steel of the 18% chromium, 8% nickel type. (Condensation of paper presented before American Institute of Mining and Metallurgical Engineers.)

3-61. **Hardenability Effects in Relation to the Percentage of Martensite.** J. M. Hodge and M. A. Orehoski. *Wire and Wire Products,* v. 21, April '46, p. 309.

Hardenability effects of the individual alloying elements, Mn, Si, Ni, and Mo, in alloy series in which these elements are the only variables are measured and compared on the basis of criteria of 50, 95, and 99.9% martensite

microstructures. (Condensation of a paper presented before American Institute of Mining and Metallurgical Engineers.)

3-62. **Fracture Characteristics.** K. Winterton. *Metal Industry,* v. 68, March 22, '46, p. 223-226.

Guide to quality in chill-cast bronzes. Correlates fracture types with mechanical properties and lists them in order of merit.

3-63. **Impact Forging Improves Steel's Physical Properties.** R. E. W. Harrison. *American Machinist,* v. 90, April 11, '46, p. 138-140.

Graphs give effect of hammer forging on the physical properties of *(a)* S.A.E. 1020 steel test bars not heat treated; *(b)* S.A.E. 3140 steel test bars normalized but not hardened; *(c)* S.A.E. 3140 test bars normalized and hardened. Tables list physical properties of S.A.E. 1020 steel, as rolled, test bars not heat treated; S.A.E. 3140 steel, as rolled, normalized; S.A.E. 3140 steel, as rolled, normalized, hardened, and drawn. Chemical analyses and heat treatments given.

3-64. **A Short Note on Superduralumin.** D. P. Chatterjee. *Engineers' Digest (American Edition),* v. 3, March '46, p. 127-129.

The constituents of superduralumin are similar to ordinary duralumin, except the increased percentages of copper and silicon in the alloy. Abstract from *Quarterly Journal of the Geological, Mining and Metallurgical Society of India,* v. 17, no. 2, 1945, p. 53-62.

3-65. **Nickel, Wrought and Cast.** *Machine Design,* v. 18, April '46, p. 175-178.

Properties; physical constants; characteristics; applications; fabrication; annealing; resistance to corrosion.

3-66. **High Temperature Steels.** *Iron and Steel,* v. 19, April '46, p. 159-160.

Some wartime results of German jet engine researches. Compositions and properties of five steels used for gas turbine blading.

3-67. **Titanium in Austenitic Stainless Steel.** *Vancoram Review,* Fall-Winter '45-46, p. 16, 18.

Titanium is used in chromium-nickel stainless steel to perform two important functions. The first is to eliminate susceptibility to intergranular corrosion; and the second, to enable the metal to be hardened by heat treatment.

3-68. **Selection of Cold Work Die Steels.** G. M. Butler. *Steel Processing,* v. 32, April '46, p. 229-233.

Tables and comparisons of various steels for cold die work, arranged to show comparative properties. Steels considered, comprising eight types of die steel, are arbitrarily divided into three groups according to quenching practice.

3-69. **Ni Span.** W. A. Mudge and A. M. Talbot. *Iron Age,* v. 157, April 25, '46, p. 66-70.

Characteristics and uses of three recently developed age-hardenable iron-nickel-titanium alloys of the Invar and Elinvar types, amenable to conventional fabricating

processes. Series of alloys encompasses low thermal expansion, high thermal expansion and constant-modulus types.

3-70. **Chromium-Manganese-Titanium and Silicon-Manganese-Molybdenum Steels.** M. P. Braun. *Engineers' Digest (American Edition)*, v. 3, March '46, p. 132.

These steels were both investigated in order to ascertain whether they were suitable as substitutes for chromium-nickel, chromium-nickel-molybdenum and tungsten steels. (Abstract from *Stal*, no. 9-10, 1944, p. 89-90.)

3-71. **The Tensile Properties of Several Special Steels and Certain Other Materials Under Pressure.** P. W. Bridgman. *Journal of Applied Physics*, v. 17, March '46, p. 201-212.

Study of effect of hydrostatic pressure on tensile properties of four stainless steels and one carbon steel exhibiting anomalous behavior with respect to a large number of steels tested for Watertown Arsenal. Various significant stresses plotted as function of strain at fracture and compared with data for 1045 steels. Results of work on antimony, cast iron, Carboloy, bismuth also included.

3-72. **Creep of Metals (Discussion).** A. McCance. *Engineering*, v. 161, March 15, '46, p. 258-259.

New theory of creep proposed. Thermal stress produced by volume changes which are connected with compressibility of the material account for changes in hardness.

3-73. **Iron-Nickel-Cobalt Alloy for Sealing to Glass.** G. D. Redston and J. E. Stanworth. *Journal of Scientific Instruments*, v. 23, March '46, p. 53-57.

Summarizes work on British-made iron-nickel-cobalt alloys of the Kovar type, intended for sealing to borosilicate glasses. Several measured expansion curves are given for these alloys, and following a discussion of the effect of composition on expansion properties a specification is suggested based on nominal composition and expansion properties.

3-74. **Graphical Methods of Representing Some Conditions of Plasticity.** William Marsh Baldwin. *Metals Technology*, v. 13, April '46, T.P. 1980, 11 p.

Huber-vonMises-Hencky Equation; strain rates and the equations of constant volume. The St. Venant equation answers the question: What will be the relative rates of deformation of the metal under particular stress system? Isometric plot. 12 ref.

3-75. **Properties of Cerium-Containing Magnesium Alloys at Room and Elevated Temperatures.** T. E. Leontis and J. P. Murphy. *Metals Technology*, v. 13, April '46, T.P. 1995, 32 p.

Results of an extensive investigation on the properties of various cerium-containing magnesium alloys in both the cast and the forged conditions. Data are presented to show the beneficial effects of increasing amounts of cerium on the mechanical properties of magnesium at elevated temperatures (strength, hardness, creep resistance and conductivity). Effects of heat treatment on the properties of these alloys and the attendant changes in the microstructure are discussed. Alloys investigated most extensively are listed. 11 ref.

3-76. **Toughness and Fracture of Hardened Steels.** Marcus A. Grossmann. *Metals Technology,* v. 13, April '46, T.P. 2020, 41 p.

Henry Marion Howe Memorial Lecture, 1945. Toughness of hardened steels; effect of shape of test piece; fracture at grain boundaries; position of weakest plane in steel; relation of variations in mode of fracture to variations in mechanical properties; effect of retained austenite; decrease in cohesive (cleavage) strength; precipitation of carbides; relation of martensite tempering to mechanical properties. 10 ref.

3-77. **Permanent Magnet Steels.** W. E. Ruder. *Iron Age,* v. 157, May 9, '46, p. 65-69.

Review of permanent magnet steels, covering their metallurgy, engineering possibilities, physical qualities and methods of fabrication. Among the materials covered in addition to the older carbon, chromium and tungsten types, are the Alnico group, Comol, Silmanal, Vectolite, Cunico, and Cunife.

3-78. **A New Copper-Phosphorus-Lead-Nickel Alloy.** Vladimir A. Grodsky. *Metal Progress,* v. 49, May '46, p. 970-972.

A new alloy of the phosphor bronze family has low melting and casting temperature, high density, good machinability, corrosion resistance and weldability. Bearing properties are favorable and cost of the alloy is low on account of the absence of tin, shorter melting time, a simpler molding technique, and the absence of heat treatment.

3-79. **Properties and Characteristics of 27% Chromium Iron.** H. D. Newell. *Metal Progress,* v. 49, May '46, p. 977-991, 993-1006, 1016, 1018, 1020, 1024, 1028.

Studies originally intended for manufacturers of raw material for synthetic rubber. Description of the alloy; properties at elevated temperatures; short-time tensile properties; creep strength of stainless steel, type 446; impact properties and notch sensitivity; effect of depth of notch on impact strength; structural characteristics; embrittlement phenomena; working and fabricating; effect of time and temperature in removing 885° F. embrittlement in 25% chromium irons; heat treat (annealing); service examinations and data; oxidation rate (in. per 1000 hr.) of various alloys after plant exposure in butadiene reactors; chemical composition versus hardness and amount of sigma constituent in 27% chromium-iron tubes after plant service. 85 ref.

3-80. **Beryllium Copper—Its Uses and Potentialities.** H. G. Williams. *Steel,* v. 118, May 13, '46, p. 88-91, 142-144.

Wide utilization of alloy due to its nonmagnetism, corrosion resistance, and high electrical conductivity. These characteristics, coupled with formability in solution-annealed state, high tensile strength, hardness, and good wear resistance, insure a wide range of performance.

3-81. **Impact Resistance of Welded Stainless.** J. G. Henderson. *Steel,* v. 118, May 13, '46, p. 94, 112.

Exact grade, welding procedure and the heat treatment required to give optimum results at low temperatures with austenitic 18-8.

3-82. **Physical Properties of Corrugated Low-Density Structures.** C. A. Scogland. *Product Engineering,* v. 17, May '46, p. 394-397.

Laboratory tests on newly developed cellular laminates of paper, cotton, fabric, glass textiles, aluminum, steel, and plywood. Methods of sample preparation. Data cover flexural strength, compressive strength, impact strength, and heat-transmission characteristics.

3-83. **Antimony in 18-8 and Plain Chromium Stainless Steels.** *Iron Age,* v. 157, May 16, '46, p. 44-50.

Results of extensive investigation of the effect of additions of antimony to 18-8 and plain chromium stainless steels. Tests embracing 36 compositions of stainless steels indicated that the effects of such additions are varied and inconsistent with respect to hot workability, machinability, physical properties and corrosion resistance.

3-84. **Fisheyes in Arc Welds.** J. B. Arthur. *Iron Age,* v. 157, May 16, '46, p. 52-53.

Data on conditions under which fisheyes will or will not occur. Table gives effect of moisture content on physical properties of weld metal.

3-85. **Chill-Cast Bronzes.** W. T. Pell-Walpole. *Metal Industry,* v. 68, April 26, '46, p. 323-324.

Percentage of porosity and corresponding tensile properties of two series of chill-cast phosphor bronzes are presented graphically.

3-86. **Tailoring 18-8.** Wilson G. Hubbell. *Steel,* v. 118, May 20, '46, p. 112-113, 136, 139-140.

Various properties of stainless steel are investigated by Ryan Aeronautical to find best formula for high-temperature exhaust manifold equipment and one amenable to forming, gas, arc and resistance welding and other fabricating processes.

3-87. **High-Temperature Alloys.** N. J. Grant. *Iron Age,* v. 157, May 23, '46, p. 42-45,48.

Summary of intensive research work with high-temperature, high-strength alloys conducted at Massachusetts Institute of Technology for the Navy. Goals were to develop superior alloys for performance in gas turbines at about 1500° F. and to find the effects of nitrogen and carbon on certain nickel-chromium-cobalt iron-base complex alloys, and the relative effects of tantalum and columbium on these alloy systems.

3-88. **Technology of Germanium.** Robert I. Jaffee, E. W. McMullen and Bruce W. Gonser. *Electrochemical Society Preprint* 89-18, April 15, '46, p. 209-221.

Properties; occurrence; extraction; possible uses. 33 ref.

3-89. **Cobalt-Base High-Temperature Alloys.** L. E. Browne. *Steel,* v. 118, May 27, '46, p. 88-90, 132.

Maintain high strength and hardness at red heat and maximum resistance to wear, heat, corrosion and erosion.

3-90. **Zirconium Metal—Manufacture, Fabrication and Properties.** D. B. Alnutt and C. L. Scheer. *Metal Industry,* v. 68, May 3, '46, p. 343-345.

Methods of production of high-purity, ductile zirconium and results of some laboratory attempts to fabricate wire and sheet from metal. Physical and chemical properties. (Paper for symposium on Electronics held by Electrochemical Society.) 14 ref.

3-91. **High-Temperature Alloys.** N. J. Grant. *Iron Age,* v. 157, May 30, '46, p. 50-56.

Preparation of vitallium-base high-temperature alloys. Tabular listing of high-temperature rupture and creep results. Discussion of various alloys found to be nonforgeable, and comparison between casting and forging grades. Nickel-chromium-cobalt-iron alloys are explored from the standpoint of the effect of variations in heat treatment on high-temperature rupture properties.

3-92. **Photo-Electric Properties of Metals in a Finely Divided State.** L. J. Reimert. *Journal of the Optical Society of America,* v. 36, May '46, p. 278-283.

Cadmium, antimony, zinc and sodium studied. Investigations restricted primarily to clean surfaces prepared either by the conventional method of distillation under the best vacuum conditions obtainable, or by cutting a fresh surface on the bulk of the metal in a vacuum.

3-93. **Die Steels for Hot Work.** D. W. Rudorff. *Alloy Metals Review,* v. 4. March '46, p. 2-6.

Report of systematic study of influence of tungsten percentage in tungsten-chromium die steel for hot work, and the complete or partial replacement of tungsten by molybdenum and/or vanadium. Work primarily concerned with properties indicated by testing at 500 to 600° C., and with the ability of steel to withstand the abrupt temperature changes to which hot work dies are exposed.

3-94. **Die Steel for Hot and Cold Work.** W. H. Wills. *Tool & Die Journal,* v. 12, May '46, p. 83-88, 122-123.

Properties and applications. Cold work die steels; water hardening steels; oil hardening steels; high carbon, high chromium steels; air hardening die steels.

3-95. **Alloys Beat the Heat.** Fred P. Peters. *Scientific American,* v. 174, April '46, p. 152-154.

Brand new alloys, and some old standbys from other fields, are key materials of turbosuperchargers, gas turbines, and jet engines. Their compositions and methods by which they were formed are now revealed.

3-96. **Creep Resistant Alloy Steels.** S. E. Wolfson and M. P. Myahkov. *Metallurgia,* v. 33, April '46, p. 287-290.

Investigation on the behavior of alloy steels at prolonged high temperatures shows that the addition of molybdenum to steel imparts high heat strength. Vanadium has a similar effect on alloy steels but to a lesser degree. (From *Stal,* no. 3 to 4, 1943, p. 42-47, and *Iron Age,* v. 156, 1945, p. 58-63.)

3-97. **Tellurium—Its Ores, Properties and Applications.** L. Sanderson. *Metallurgia,* v. 33, April '46, p. 291-292.

Ores and methods for extracting the metal; properties and applications. Tellurium is most interesting from an electrochemical point of view. Its most important applications are in metallurgy, particularly in lead.

3-98. **Low-Copper Special Brasses.** E. Vadess, E. Lay, and J. Fankhaenel. *Metallurgia,* v. 33, April '46, p. 325-326.

Various advantages are offered by the special low-copper brasses, as compared with the normal brasses, such as higher mechanical strength, greater chemical stability, and other valuable technical properties, such as applicability to use as bearing metals, etc.

3-99. **Shear Properties of Metals and Alloys.** *Materials & Methods,* v. 23, May '46, p. 1341-1345.

Tables give material and specification, condition, shear strength, modulus of elasticity, and ratio of shear to tensile strength for copper alloys, nickel alloys, irons, and steels.

3-100. **Beryllium: Workaday Metal.** Fred P. Peters. *Scientific American,* v. 174, June '46, p. 249-251.

Expensive and hard to work in pure state, it alloys with other metals to provide properties otherwise unobtainable. Main use is in beryllium-copper combinations.

3-101. **The Magneto-Resistance of High Coercivity Alloys.** L. F. Bates. *Proceedings of the Physical Society,* v. 58, March '46, p. 153-164.

Measurements have been made of the change of resistance of ferromagnetic alloys of high coercivity when exposed to longitudinal and transverse magnetic fields. Changes for the permanent magnet materials Alni, Alnico (cast and sintered) and Alcomax II are in marked contrast to those of pure ferromagnetic metals. Results are discussed on the basis of the domain concept in ferromagnetism.

3-102. **High Impact Values of Steel Castings for Use at Extremely Low Temperatures.** *Machinery,* v. 52, June '46, p. 190-191.

Charts have been prepared showing the impact characteristics of castings produced for subzero service. Curves illustrate impact values for the normalized and tempered and the quenched and tempered conditions, respectively.

3-103. **Copper-Manganese-Zinc Alloys.** R. S. Dean, J. R. Long, T. R. Graham and R. G. Feustel. *Metal Industry,* v. 68, May 24, '46, p. 403-406.

Cold working produces a tensile strength of over 50 tons per sq. in. and an elongation of 3% in a copper-manganese-zinc alloy containing 5% manganese. Physical properties of alloys containing up to 35% manganese are studied. (Read before American Institute of Mining and Metallurgical Engineers.)

3-104. **Essential and Fundamental Characteristics of the Strength Properties of a Material.** Carl Benedicks. *Metal Treatment,* v. 8, Spring, '46, p. 53-59.

Discussion of recent work regarding the terminological relationship between certain fundamental qualities. Simplifying the stress-strain diagram; upper yield point. (From *Jernkontorets Annaler.*)

3-105. **Major Improvement in High Speed Steels.** *Machine Tool Blue Book,* v. 42, June '46, p. 233-234.

Process achieves a more even distribution of free car-

bides throughout the steel and elimination of their segregation in the center. In shop performance, Desegatized steel shows uniformly excellent results under heat treatment, longer tool life, longer run between grinds, reduction of warpage and breakage to a minimum, and all-around more consistent tool performance.

3-106. **Effect of "Fisheyes" on Impact Strength of High-Tensile Manganese-Titanium Steel Plate.** M. R. Gross, W. R. Angell and G. D. Marshall. *Metal Progress,* v. 49, June '46, p. 1173-1180.

Effect of factors contributing to the formation of fisheyes on physical properties and, in particular, on impact strength of Mn-Ti steel in the as-rolled and aged conditions.

3-107. **Superalloys for High-Temperature Service.** Harold A. Knight. *Materials & Methods,* v. 23, June '46, p. 1557-1563.

Heat resistant materials developed for gas turbines and related uses. Included is a table of high-temperature alloys.

3-108. **Chromium-Vanadium Carburizing Steel "6120".** F. F. Franklin. *Materials & Methods,* v. 23, June '46, p. 1564-1566.

Changes in composition of 6120 carburizing steel increase hardenability and permit an increase in section in which it can be applied.

3-109. **Carbon Absorption of 18-8 Stainless Steel.** Wilson G. Hubbell. *Iron Age,* v. 157, June 20, '46, p. 56-59.

An investigation to determine whether the stainless steel used for aircraft exhaust manifolds picks up carbon from the high temperature exhaust gases is reported. Photomicrographs and carbon differences covering several hot and several cool operating areas for a number of burned-out manifolds are given. Poor cooling and excessive temperatures are more often the reason for failure than intergranular corrosion from precipitated carbides.

3-110. **High-Temperature Alloys.** N. J. Grant. *Iron Age,* v. 157, June 20, '46, p. 60-63.

Following a brief discussion of the microstructures of the Ni-Cr-Co-Fe base alloys, the author explores the Vitallium alloys with respect to physical properties and the effects on properties of mold preheat and heat treatment. High temperature failure and strength and ductility comparisons among the alloys are also presented.

3-111. **Beryllium Alloys—Physical Properties and Production Applications.** N. W. Bass. *Tool & Die Journal,* v. 12, June '46, p. 95-98.

History and production of beryllium; production of beryllium-copper master alloy; physical properties of beryllium and beryllium-copper alloys. 3 ref.

3-112. **Thermal Characteristics, Microstructures and Physical Properties of Some Low and Medium Alloyed Cast Steels.** W. L. Meinhart. *Iron Age,* v. 157, June 27, '46, p. 45-53.

Investigation covered both rapid and slow cooling rates as well as the influence of specific alloying agents. Illus-

trates a number of points of especial value in determining heat treatment and welding procedures for a given steel. Much of the data covered may also be applied, within limitations, to wrought steels.

3-113. **Some Recent Trends in Alloy Steels.** Robert S. Archer. *Steel Processing,* v. 32, June '46, p. 363-367, 371, 388-389.

Development of N.E. steels; hardenability; work on stress raisers and brittle failures; development of H steels; performance factors. (Paper presented before summer meeting, Society of Automotive Engineers.) 18 ref.

3-114. **Gray Iron Wear Resistance.** F. G. Sefing. *American Foundryman,* v. 9, June '46, p. 77-79.

Comparison of gray irons showing good to bad metal-to-metal wear resistance has proved that variations in microstructure are associated with wear performance. Superior wear and galling resistance of gray iron is achieved with a complete and fine pearlitic matrix with A. F. A. Type A graphite. Coarse pearlite, free ferrite or cementite in the matrix and A. F. A. Types D and E graphite decrease the wear and gall resistance.

3-115. **The Effect of Phosphorus on the Properties of Gun Metal—Reducing Conditions.** Robert A. Colton and Blake M. Loring. *Metals Technology,* v. 13, June '46, T. P. 1974, 13 p.

Since it appears impractical to try to control the amount of oxygen introduced into the metal, it would seem that control of the oxygen content of the liquid metal offers the most promising approach to this problem. This may be done by the use of slags, or covers, or by an addition to the melt to remove oxygen preferentially. Evidence at hand is controversial, especially on the possibility of using a chemical deoxidizer to control the oxygen content of bronzes. 22 ref.

3-116. **A Precipitation-Hardening Stainless Steel of the 18% Chromium, 8% Nickel Type.** R. Smith, E. H. Wyche, and W. W. Gorr. *Metals Technology,* v. 13, June '46, T. P. 2006, 31 p.

Content of the austenite-forming elements is on the low side (nickel 7%, manganese 0.5%, carbon 0.06%, nitrogen 0.02%). Chromium is also low (17%); melts are deoxidized with enough aluminum for 0.20 residual. Titanium (or columbium) is the element which induces age hardening; it is 0.7 to 0.9%. Solution treatment is ½ hr. at 1900° F.; on air cooling the alloy changes almost completely to alpha plus delta ferrite; the hardening constituent is precipitated during 30 min. aging at 950° F. A rapid cooling will then maintain good impact strength. Mechanical properties in plates and forgings equal the high values achieved in standard 18-8 sheet, strip or wire only after the optimum amount of cold rolling or drawing. 60 ref.

3-117. **Some Properties of Sand-Cast Alloys in the Magnesium-Rich Corner of the Magnesium-Aluminum-Zinc System.** R. S. Busk and R. F. Marande. *Metals Technology,* v. 13, June '46, T. P. 2009, 9 p.

Comprehensive data presented on various properties of

magnesium-rich sand-cast Mg-Al-Zn alloys, in graphical form including constitutional, casting, and mechanical properties. Various graphs show optimum properties at different compositions.

3-118. **The Effects of Aluminum on the Constitution and Working Properties of Tin Bronzes.** W. T. Pell-Walpole, V. Kondic, and P. G. Forrester. *Journal of the Institute of Metals,* v. 72. May '46, p. 293-316.

Solidus and α solubility limits have been determined for a range of aluminum-tin bronzes containing 5 to 18% of tin and 0 to 8% of aluminum. Difficulties encountered in hot or cold rolling the α alloys are shown to be associated with interdendritic porosity, which, in certain alloys, becomes extensive on annealing before working. Work hardening and annealing characteristics of degassed alloys of all compositions examined are in general similar to those of binary tin bronzes. Mechanical properties vary regularly with both tin and aluminum contents, 1% of aluminum being equivalent to approximately 2% of tin in this respect. Maximum values of tensile strength obtained are given.

3-119. **En. Steels—Some Wartime Experiences.** E. Wood. *Iron and Steel,* v. 19, June '46, p. 367-372.

Experiences which were met with in a serious attempt to make as wide and positive use as possible of the En. steels and thereby save alloying elements for the total war effort and secure secondary but important economies in simpler design, and simpler process and purchasing schedules.

3-120. **Secret Wartime High-Temperature Alloys Now Available for Peacetime Use.** *Machinery,* v. 52, July '46, p. 183-187.

Several Haynes Stellite alloys have been developed during the war that are finding peacetime applications in fields calling for high-temperature creep and rupture strengths.

3-121. **Aluminum-Beryllium Alloys.** R. H. Harrington. *Metal Industry,* v. 68, June 28, '46, p. 513-515.

The heat treatable alloys described develop superior strength properties as castings made by gravity-sand, centrifugal and lost-wax methods, combined with high thermal stability and unusual oxidation-corrosion resistance. Also develop useful wrought properties. (Abridged reproduction of a paper for American Society for Metals.)

3-122. **A Thermodynamic Criterion for the Fracture of Metals.** Edward Saibel. *Physical Review,* v. 69, no. 11 and 12, June 1 and 15, '46, p. 667.

Develops equations for strain energy of metals. Brittle fracture stress so calculated agrees well with observed values.

3-123. **The Properties and Influence of Several Less Common Elements When Added to Cast Iron. Part III.** J. E. Hurst. *Pig Iron Rough Notes* no. 102, Spring-Summer '46, p. 13-16.

Antimony; lead; bismuth; uranium.

3-124. **Ductile Titanium. Part I.** *Metal Industry,* v. 69, July 5, '46, p. 7.

Preparation; fabrication; properties.

3-125. **Beryllium Alloys—Physical Properties and Production Applications. Part II. Applications of Common Alloys.** N. W. Bass. *Tool & Die Journal,* v. 12, July '46, p. 86-89.

Applications and properties of the beryllium-copper alloys, particularly the 2% beryllium alloy and a second, less well-known alloy containing from 0.25 to 0.50% beryllium with from 1.50 to 2.50% of nickel or cobalt; also beryllium nickel. Stainless steels containing beryllium.

3-126. **Graphitization in Some Cast Steels.** A. J. Smith, John Urban, and J. W. Bolton. *Welding Journal,* v. 25, May '46, p. 257s-268s.

Graphitization of carbon-molybdenum steel cannot be prevented by any of the controlled procedures of melting and deoxidation practice or heat treatment. A hypothesis has been put forth concerning the mode of graphitization based on the observed graphitization behavior of both plain carbon and carbon-molybdenum steels. Use has been made of this hypothesis to explain the resistance to graphitization of the nickel-chromium-molybdenum steels. 14 ref.

3-127. **Melting Points of Metals and Alloys.** H. R. Morrison. *Welding Journal,* v. 25, June '46, p. 545-546.

A chart gives melting points for metals and alloys, melting-point range of classes of alloys, and a color scale for various temperatures.

3-128. **Summary Report on the Joint E.E.I.-A.E.I.C. Investigation of Graphitization of Piping.** S. L. Hoyt, R. D. Williams and A. M. Hall. *Welding Journal,* v. 25, June '46, p. 332s-339s.

A summary of the findings to date on graphitization investigations, both at Battelle and elsewhere. Influence of deoxidation and alloying elements; effect of prior heat treatment and structure; influence of stress and strain; effect of joint preparation; kinetics of graphitization.

3-129. **Aluminum Alloy.** R A. Quadt. *American Foundryman,* v. 10, July '46, p. 21-34.

An investigation of the effect of certain elements on the mechanical properties of an aluminum sand casting alloy with a composition of 1% copper, 5% silicon, and 0.5% magnesium. 10 ref.

3-130. **Cast Steels—Low-Temperature Properties.** C. E. Sims. *American Foundryman,* v. 10, July '46, p. 49-66.

Twenty-eight cast steels were tested to determine their notched-bar behavior at temperatures between 80 and —100° F. Data indicated that the notched-bar properties characteristic of a heat of steel were not reflected consistently by any other property measured.

3-131. **The Hardenability of Steel.** *Metallurgia,* v. 34, June '46, p. 67-68.

Review of recent American investigations on hardenability of steel dealing with such aspects of the subject as relationship between hardenability and percentage of

martensite in some low alloy steels, the influence of titanium on hardenability of steel and determination of the most efficient alloy combinations for hardenability.

3-132. **The Importance of Ultimate Extension as an Engineering Property of Materials.** A. Fisher. *Metallurgia,* v. 34, June '46, p. 77-84.

A condition of specific strain is far more common in engineering structures than is generally supposed; under condition of specific strain it is quite useless to put in material with a higher modulus of elasticity, higher proof strength or higher anything which moves stress-strain curve to the left, in the hope that higher strength will result, because such a move merely results in a higher stress being generated. Under conditions of specific strain a component fractures if its available percentage extension is below that required under the imposed strain, irrespective of its strength. Percentage ultimate extension is a valuable property in any material to be used where stress concentrations exist. Higher percentage extension may mean greater safety in the event of abnormal loads, and not necessarily greater weight.

3-133. **Some Investigations of 18-8 Stainless Steel.** Wilson G. Hubbell. *Steel Processing,* v. 32, July '46, p. 455-459.

Describes some experimental work performed by Ryan Laboratory to determine most desirable formula for aircraft engine exhaust manifolds. Three groups tested. One was in the "as received annealed" condition. Second sample was in the "annealed" condition. Other samples were investigated in the "work hardened" condition. Chemical composition and properties are given.

3-134. **English Steels and Their American Equivalents.** T. W. Gorgon. *Machinery (London),* v. 69, July 4, '46, p. 17-20.

Tables give chemical composition, heat treatment and mechanical properties of the English E.N. steels as compared to the American S.A.E. steels.

3-135. **Toolsteels—Types and Treatment.** Robert S. Burpo, Jr. *Materials & Methods,* v. 24, July '46, p. 119-134.

Careful consideration to time and temperatures and to what happens to steel at various points in the heating and cooling cycle is necessary to make available useful qualities latent in toolsteels. Information presented on the various types, compositions and uses of toolsteels available today.

3-136. **Shear Properties of Metals and Alloys. Part 3: Magnesium Alloys.** *Materials & Methods,* v. 24, July '46, p. 143, 145.

Tables give shear strength and ratio of shear to tensile strength for various commercial specifications of magnesium alloys.

3-137. **The Sorption of Water Vapor at Low Pressure on the Surface of Some Cold Rolled Steels at 20°.** Marion H. Armbruster *Journal of the American Chemical Society,* v. 68, July '46, p. 1342-1347.

The sorption of water vapor at 20° and pressures up to 0.15 cm. has been measured on two surfaces of cold

rolled, mild carbon steel on which the sorption of other gases had previously been measured; also on a stainless alloy containing 18% chromium and 8% nickel.

3-138. **The Adsorption of Oxygen at Low Temperature and Pressure on Smooth Iron.** Marion H. Armbruster and J. B. Austin. *Journal of the American Chemical Society,* v. 68, July '46, p. 1347-1354.

The sorption of oxygen on three smooth surfaces of iron (cold rolled steel), on which the sorption of other gases had also been determined, was measured at 20°, —78° and —183° and at pressures up to 0.1 cm. Sorption on each surface was observed first after degreasing and outgassing, subsequently on the same sample after it had been reduced in purified hydrogen and again outgassed.

3-139. **Corrosion Resistant Alloys. Part 2.** *Steel,* v. 119, July 29, '46, p. 70-75, 112.

Four metals finding wide use in industries which handle such reactive acids as boiling hydrochloric, sulphuric and hot nitric are Hastelloy alloys A, B, C and D—a series of high-strength nickel-base alloys which can be readily fabricated. Tables give mechanical properties, corrosion resistance, recommended machining speeds and feeds, and grinding wheel recommendations for grinding.

3-140. **Intermediate Manganese Steels.** G. P. Contractor and J. S. Vatchaghandy. *Iron and Steel,* v. 19, July '46, p. 427-429.

Properties of steels made with alloying elements found within India's own limits. (From *Journal of Scientific and Industrial Research.*)

3-141. **Heat Resisting Steels.** *Iron and Steel,* v. 19, July '46, p. 433-435.

Performances and physical properties of the German Krupp steels Tinidur and Cromadur are detailed, and are shown in tables. Analyses of other steels developed in order to overcome the scarcity of certain elements are given, together with purposes for which they were designed. Some of their physical properties are shown.

3-142. **A Comparison of Some Carbon Steels on the Basis of Various Creep Limits.** A. E. Johnson and H. J. Tapsell. *Institution of Mechanical Engineers Proceedings,* v. 153, '45, War Emergency Issue no. 6, p. 169-179.

Report has been prepared with a view to determining whether any relationship exists between the results of the various short-time and long-time creep tests, which will permit the use of short-time tests, not merely as a means of separating good from bad steels, but also as the basis of design stresses intended to give satisfactory performance of the steel over working periods of considerable duration.

3-143. **Creep Properties of Steels Utilized in High-Pressure and High-Temperature Superheater and Steam Pipe Practice. Part II: 0.5% Molybdenum Steels.** H. J. Tapsell and R. W. Ridley. *Institution of Mechanical Engineers Proceedings,* v. 153, '45, War Emergency Issue no. 6, p. 181-192.

Creep properties of carbon-molybdenum steels in the form of a superheater header, superheater tube, and

steam pipe manufactured for service at temperatures above about 450° C. Data for the estimation of stress-temperature relationships for from 0.1 to 0.5% creep in various periods up to 100,000 hr.

3-144. **Effect on Fatigue Strength.** W. Ker Wilson. *Institution of Mechanical Engineers Proceedings,* v. 153, '45, War Emergency Issue no. 10, p. 347-351.

The influence of cutting, grinding, and polishing operations on fatigue strength depends greatly on individual circumstances; it is less marked for mild steels than for high-strength alloy steels, and may be favorable or unfavorable according to the fineness of the finish and the nature of the residual stresses. Residual tensile stresses are harmful, whereas, within proper limits, residual compression stresses may be beneficial. (Paper for Symposium on Surface Finish.)

3-145. **Magnesium Alloys.** *Metal Progress,* v. 50, Aug. '46, p. 308-B.

Data sheet giving compositions, properties, and designations of American commercial alloys.

3-146. **Behavior of 18-8 Ti-Stabilized Stainless. Part I.** Ernest H. Wyche. *Iron Age,* v. 158, Aug. 8, '46, p. 61-65.

Various means for detecting and combating intergranular corrosion in 18-8 stainless steel. Effects of the stabilizing elements, titanium and columbium, on the physical properties of wrought 18-8 stainless steels are considered together with precautions to be observed in calculating proper ratios of these elements for best results. 22 ref.

3-147. **Nickel Silvers (Materials Work Sheet).** *Machine Design,* v. 18, Aug. '46, p. 159-162.

Nominal analyses; properties; characteristics; applications; fabrication; corrosion resistance.

3-148. **Low-Temperature Behavior of Ferritic Steels.** H. W. Gillett and Francis T. McGuire. *Steel,* v. 119, Aug. 12, '46, p. 76, 98, 100, 103-104.

Comprehensive data secured from experimental work carried out as a War Metallurgy Committee project correlate and clarify some points of low-temperature behavior of commercial N.E., S.A.E., and similar steels relating to composition, heat treatment, grain size, hardenability, etc., and also corroborate conclusions obtained in earlier investigations of similar nature.

3-149. **Formulas for Determining the Properties of Copper Wire in the American Wire Gage.** Carl P. Nachod. *Product Engineering,* v. 17, Aug. '46, p. 159.

Table gives simple formulas of sufficiently close accuracy to obtain the properties of any size copper wire in the American or Brown and Sharpe gage.

3-150. **Behavior of 18-8 Ti-Stabilized Stainless. Part II.** Ernest H. Wyche. *Iron Age,* v. 158, Aug. 15, '46, p. 54-56.

Effects of temperature on the physical properties and creep strength of columbium and titanium-stabilized types of 18-8 stainless steels are discussed. Weldability, corro-

sion resistance and stabilization heat treatment are compared from the viewpoint of determining suitable commercial applications. 11 ref.

3-151. **The Hot Tearing Tendencies of Aluminum Casting Alloys.** D. C. G. Lees. *Metal Treatment,* v. 13, Summer '46, p. 142-144.

Hot tearing behavior of a number of commercially used alloys studied under controlled conditions outlines mechanism of hot tearing and makes recommendations for its avoidance. (Paper for Institute of Metals.)

3-152. **Selection of Die Steels for Cold Working Metals.** G. M. Butler. *Steel,* v. 119, Aug. 19, '46, p. 124, 127.

Steels are divided into three groups, according to the quenching medium used in their hardening. Classified as to water, oil and air hardening steels, their properties have a direct relationship to the manner of hardening. Grouping according to quenching method is shown, and peculiar characteristics that make each type suitable for a particular type of cold working die given.

3-153. **New Aluminum Alloys Containing Small Amounts of Beryllium.** R. H. Harrington. *Modern Metals,* v. 2, Aug. '46, p. 18-22.

Two heat treatable alluminum alloys used in tests. Melting and heat treating procedures employed; tensile properties; methods of casting. Investigation also indicates that useful wrought properties may be obtained from the alloys. (Paper for American Society for Metals, Feb. 1946.)

3-154. **Some Properties and Applications of Aluminized Steel.** *Modern Metals,* v. 2, Aug. '46, p. 14-16.

Material has advantages over zinc, tin or lead coatings on steel, in that resistance to corrosion, heat and oxidation is superior. Material is attractive, strong and has excellent heat reflectivity. Describes some of these properties, the welding technique and some typical applications.

3-155. **Causes and Prevention of Intergranular Fracture in Cast Steel.** C. H. Lorig. *Electric Furnace Steel Proceedings A.I.M.E.,* v. 3, 1945, p. 234-240; discussion, p. 240-251.

Precipitation of aluminum nitride; prevention of intergranular fracture; time-temperature effects; ferrite precipitation; type II inclusions. Prime causes found were aluminum nitride precipitation at primary grain boundaries and ferrite precipitation as a network on the primary grain boundaries.

3-156. **Triple Alloy Structural Tubing.** C. M. Schwitter. *Iron Age,* v. 158, Aug. 22, '46, p. 46-49.

Effect of heat treatment on physical properties of various sizes of tubing made of 8630 steel; results of weldability tests conducted under variable conditions. 6 ref.

3-157. **How High Nickel Alloy Irons Fit the Production Picture.** Frederick G. Sefing. *Western Metals,* v. 4, Aug. '46, p. 15-20.

Description of the various alloys, known as Ni-Resist, together with an explanation of their chemical, physical

and mechanical properties to guide in making appropriate applications of these metals.

3-158. **New Type Stainless May Find Important Market in Petroleum Industry.** John S. Ewing. *Western Metals,* v. 4, Aug. '46, p. 27-30.

Description of "Stainless W" steel, its properties and the results of meager fabricating experience.

3-159. **White and Gray Irons.** R. A. Flinn and H. J. Chapin. *American Foundryman,* v. 10, Aug. '46, p. 47-59.

White, mottled and gray irons can be manufactured with definite elasticity and ductility as well as reproducible tensile strength and other properties. As the matrix structure is changed from pearlitic to austenitic, the plastic elongation changes from 0.0000 to 0.0500% in white and mottled irons and from 0.05 to 3.0% in gray iron. Ferritic-pearlitic gray irons exhibit up to 1.0% elongation. Modulus of elasticity varies from 26.0 to 10.4×10^6 psi. depending upon the structure.

3-160. **Characteristics of Low-Alloy High-Tensile Steel.** J K. Zanetti. *Materials & Methods,* v. 24, Aug. '46, p. 370-373.

Behavior of high-tensile steels as compared to carbon steels; workability and weldability.

3-161. **Developments in Low-Alloy Steels for Welding Construction.** A. J. K. Honeyman and J. Erskine. *Metallurgia,* v. 34, July '46, p. 133-139.

Range of 0.14 to 0.20% carbon is given and in order to obtain a yield strength of 25 tons per sq.in. the effect of alloy additions is considered and particular attention directed to a manganese-molybdenum steel which satisfactorily fulfills requirements.

3-162. **Effects of Grain Growth Inhibitors in Fine-Grained Steels.** James W. Halley. *Steel,* v. 119, Sept. 2, '46, p. 98-99, 124.

Quantitative data concerning how much a certain amount of aluminum, titanium, or zirconium raises the coarsening temperature and affects the properties. (Paper for American Institute of Mining and Metallurgical Engineers.)

3-163. **Melting Points of Metals and Alloys.** *Industry and Welding,* v. 19, Aug. '46, p. 34.

Chart gives quick, easy way to find them.

3-164. **On Temperature Dependence of the Coercive Force in Single Crystals of Transformer Steel.** J. Shur. *Journal of Physics (U.S.S.R.),* v. 10, no. 3, '46, p. 299 (in English).

Relation between coercive force and temperature reveals a distinct dependence upon the crystallographic directions along which the observations are made. Gives results of experiments at 20° and −195° C.

3-165. **Notch Sensitivity in High-Strength Aluminum Alloys—Theoretical Aspects.** L. Schapiro and H. E. North. *Journal of the Aeronautical Sciences,* v. 13, Aug. '46, p. 391-395.

Study of the effect of various types of notches and notched depths on static ultimate tensile strength of

14S-T, 75S-T, and 24S-T aluminum alloys. An ideal stress notch insensitive material is defined in terms of a logarithmic relationship between notched ultimate stress and notch depth. Test data indicate that the logarithmic relationship is a good first approximation and that a scale of stress notch sensitivity may be established. (Part I of a Symposium on "Notch Effects in High-Strength Aluminum Alloys".)

3-166. **The Effects of Open Holes on the Tensile Strength of Some Aluminum Alloys.** C. H. Stevenson. *Journal of the Aeronautical Sciences,* v. 13, Aug. '46, p. 395-397.

Experimental data to show the effect of holes on the ultimate tensile strength of 14S-T, 24S-T, and 75S-T aluminum alloys. Curves useful in design are given to show the effect of single and multiple holes of various sizes in plates, bars, and extrusions. (Part II of Symposium on "Notch Effects in High-Strength Aluminum Alloys".)

3-167. **Notch Effects in High-Strength Aluminum-Alloy Spar Caps.** D. L. Moseley. *Journal of the Aeronautical Sciences,* v. 13, Aug. '46, p. 397-401.

Three spar cap configurations were investigated for the effects of stress concentrations caused by large bolt holes in 14S-T and 75S-T spar caps. Test results and conclusions. (Part III of Symposium on "Notch Effects in High-Strength Aluminum Alloys".)

3-168. **The Effect of Notches Upon Limiting Strain in High-Strength Aluminum Alloys.** O. A. Wheelon and St. J. Barrett. *Journal of the Aeronautical Sciences,* v. 13, Aug. '46, p. 401-404.

Bending tests were conducted on ½-in. square, notched bars of 14S-T, 24S-T, and 75S-T. Notches of any depth drastically reduce the limiting strain for all materials tested and for all testing temperatures. Data presented graphically. (Part IV of Symposium on "Notch Effects in High-Strength Aluminum Alloys".)

3-169. **Anelasticity of Metals.** Clarence Zener. *Metals Technology,* v. 13, Aug. '46, T. P. 1992, 35 p.

Reviews and correlates past work on anelasticity (elastic aftereffect). Mathematical formulation, physical origins and the potential importance of anelasticity. Anticipates that relaxation spectra will be valuable in reading an understanding of the mechanical behavior of metals. 126 ref.

3-170. **Elastic Aftereffects in Iron Wires From 20° to 550° C.** William A. West. *Metals Technology,* v. 13, Aug. '46, T. P. 1993, 28 p.

Explores the possibilties of properly designed and interpreted experiments on the elastic aftereffect in metals. Wires were subjected to given constant torsional strains, under given conditions, and the recoveries after release were observed in more or less detail.

3-171. **The Effect of Hydrostatic Pressure on Plastic Flow Under Shearing Stress.** P. W. Bridgman. *Journal of Applied Physics,* v. 17, Aug. '46, p. 692-698.

Measurements of the forces required to drive a punch

into plates of several grades of steel as a function of the distance of penetration, the entire punching operation being conducted in a fluid medium subjected to hydrostatic pressures up to 30,000 kg. per sq.cm. Ductility is greatly increased, and greatly increased distortion is tolerated without fracture

3-172. **F-3 Lead Alloy—an Improved Cable Sheathing.** L. F. Hickernell and C. J. Snyder. *Electrical Engineering,* v. 65, Aug-Sept. '46, p. 563-569.

Modern requirements as met by new Anaconda alloy. Details concerning composition, bending, abrasion and creep resistance; effect of aging on tensile strength and ductility; bursting strength of tubes; vibration fatigue and corrosion. 16 ref.

3-173. **Tensile Properties Affecting the Formability of Aluminum Alloy Sheet at Elevated Temperatures.** A. E. Flanigan, L. F. Tedsen, and J. E. Dorn. *Journal of the Aeronautical Sciences,* v. 13, Sept. '46, p. 457-468.

Tensile properties thought to influence formability have been determined for 15 aluminum alloy sheet materials tested at elevated temperatures. Complete load-extension diagrams have been obtained, and effects of temperature, strain rate, and exposure time have been noted.

3-174. **Copper and Copper-Base Alloys. (Continued.)** J. W. Donaldson. *Metal Industry,* v. 69, Aug. 30, '46, p. 171-173.

Continues survey of American research on copper and its alloys up to the end of 1945. Copper-manganese-zinc alloys; powder metallurgy products; bearing alloys. 11 ref.

3-175. **Precision Casting Heat Treatable Copper-Base Alloys.** H. Rosenthal, S. Lipson and H. Markus. *Iron Age,* Sept. 19, '46, p. 48-54.

Investigation of the properties of cast aluminum bronze and beryllium copper resulting from the heat treatment of precision investment cast specimens. Novel feature of research was adaptation of insulating properties of the investment by quenching while the alloy was still in the solid solution temperature range.

3-176. **Spot Weld Strengths and Structures of 75S-T Alclad Aluminum Alloy.** Mario L. Ochieano. *Product Engineering,* v. 17, Sept. '46, p. 102-105.

Preparation of surfaces for spot welding, effects of aging on types of weld failures, and hardness surveys of spot welded areas. Strengths and structures of spot welds in 75S-T alclad aluminum alloy are compared and correlated with the corresponding properties of 24S-T alloys.

3-177. **Precision-Cast Parts of High-Temperature Alloys.** W. O. Sweeny. *Product Engineering,* v. 17, Sept. '46, p. 121-126.

Physical and mechanical properties, creep data and chemical composition of five Haynes-Stellite alloys. Design data are given dealing with tolerances on dimensions, weight and dimensional limitations on sizes of precision-cast parts and types of parts generally suited for manufacture by precision casting methods.

3-178. **Heat and Corrosion Resistant High-Temperature Alloys.** *Product Engineering,* v. 17, Sept. '46, p. 151, 153, 155, 157.

Physical property values are results of tests conducted on chromium-nickel and chromium-nickel-cobalt alloys by Allegheny Ludlum laboratories. Also includes data obtained by the University of Michigan, Battelle Memorial Institute, and the General Electric and Westinghouse laboratories.

3-179. **Test Bar Data Vs. Casting Properties.** C. R. Austin. *Iron Age,* v. 158, Sept. 26, '46, p. 70-73.

Strength requirements of Meehanite castings of various designs and sections. Explains why the tensile properties obtained from the 1.2-in. arbitration bar are misleading when an attempt is made to apply the data to castings of greater dimensions. Significance of solidity penetration power also described.

3-180. **The Evaporation of Antimony.** Louis Harris. *Journal of Applied Physics,* v. 17, Sept. '46, p. 757.

Aggregate formation observed in evaporation of antimony has been found to have a counterpart in a simultaneous decrease in electrical resistivity of thin antimony deposits. Evaporation procedure has been modified as a result of these findings to produce films having lower electrical resistivity and higher thermal e.m.f. than obtained previously. Describes "meter" used to follow progress of evaporation. It may be used for metals other than antimony.

3-181. **The Plastic Deformation of Noncubic Metals by Heating and Cooling.** W. Boas and R. W. K. Honeycombe. *Proceedings of the Royal Society,* v. 186, June 4, '46, p. 57-71.

Several pure metals were subjected to cyclic thermal treatment between 30 and 150° C. Specimens of zinc, cadmium and tin showed signs of plastic deformation which were evident after a small number of cycles, and which became more pronounced as the number of cycles increased. On the other hand, the phenomenon was not observed in lead. Evidence is brought forward to show that this deformation is due to the anisotropy of thermal expansion in the crystals of noncubic metals. Some possible theoretical and practical implications of the phenomenon are discussed.

3-182. **Precipitation Hardened Super Heat Resistant Alloys.** R. B. Gordon. *Steel Processing,* v. 32, Sept. '46, p. 561-564, 584.

Nominal composition, physical constants and properties of two alloys (K42B and Refractaloy 70) which will operate satisfactorily at temperatures over 1200° F. and under stresses exceeding 20,000 psi.

3-183. **"Kumanal" Resistance Wire.** *Wire Industry,* v. 13, Sept. '46, p. 503.

A new copper-base alloy, remarkable for its very low temperature coefficient—closely approaching zero over the range of temperatures 20 to 350° C.

3-184. **Chromium-Vanadium Carburizing Steels and Their Modifications.** F. F. Franklin and B. B. Beckwith. *Vancoram Review,* v. 5, no. 1, 1946, p. 3-5, 18-19.

Effects upon core properties of variations in the carbon, manganese, chromium, and vanadium contents of chromium-vanadium carburizing steels.

3-185. **Vanadium Data Sheet. Wrought Constructional Steels in Light Sections. Part 2.** T. W. Merrill. *Vancoram Review*, v. 5, no. 1, 1946, p. 10-11, 21.

Wrought vanadium steels (carbon-vanadium, manganese-vanadium, nickel-vanadium types) in light sections, except the chromium-vanadium types.

3-186. **The Role of Vanadium in Gray Iron Castings—Part I.** R. G. McElwee and T. E. Barlow. *Vancoram Review*, v. 5, no. 1, 1946, p. 14-19.

More recent developments of vanadium as an alloying element. General trends; some specific examples. Includes tables.

3-187. **The Mechanical Equation of State.** John H. Hollomon. *Metals Technology*, v. 13, Sept. '46, T.P. 2034, 9 p.

Theory that the stress required for flow depends upon instantaneous values of strain, strain rate and temperature, and not upon their past values, is analyzed. Significance and possible range of applicability of this idea and its influence on accepted ideas concerning creep are evaluated. New experiments are suggested to elucidate the nature of creep and to check the validity of concept of the mechanical equation of state. 11 ref.

3-188. **Solubility of Hydrogen in Electrolytic Manganese and Transition Points in Electrolytic Manganese.** E. V. Potter and H. C. Lukens. *Metals Technology*, v. 13, Sept. '46, T.P. 2032, 12 p.

Absolute solubility was determined by a method not requiring complete degassing of the metal before the determination and checked by direct solubility determinations on degassed, electrolytic, and vacuum-distilled metal. Variation of solubility with temperature was determined from 25 to 1300° C., and variation of solubility with pressure was determined for constant temperature. Three transitions were found in solid electrolytic manganese and the transition temperatures determined. Transition temperatures determined by thermal analysis and heat content determinations are given, and the most probable transition points given.

3-189. **Effect of Alloys in Steel on Resistance to Tempering.** Walter Crafts and John L. Lamont. *Metals Technology*, v. 13, Sept. '46, T.P. 2036, 21 p.

From a study of hardness changes caused by tempering, a method has been developed for prediction of hardness and tensile strength of steel in the tempered condition. Ratio of softening resistance to hardening power of alloying elements increases in the following order: boron, carbon, manganese, nickel, chromium, molybdenum, silicon, and vanadium. 11 ref.

3-190. **Metallurgy for Welders. Part II. Testing of Weld and Plate Material.** D. Llewellyn. *Welding*, v. 14, Sept. '46, p. 427-430.

Behavior of metals from the welder's point of view. Straightforward definitions of the properties of metals.

3-191. **Carbon and Alloy Steel Materials for Cold Formed Springs.** F. P. Zimmerli. *Product Engineering*, v. 17, Oct. '46, p. 119-122.

Properties of the types of steel commonly used for the manufacture of cold formed springs. Special emphasis is given to the proper choice of material to meet various service conditions such as impact loading, elevated temperatures or corrosive atmospheres.

3-192. **Antimonial 70:30 Brass.** D. McLean and L. Northcott. *Journal of the Institute of Metals,* v. 72, Aug. '46, p. 583-616.

Part I deals with the hot and cold rolling behavior and some mechanical properties of three series of 70:30 brass containing antimony, antimony plus lead, and antimony plus sulphur, respectively. In Part II microstructure of the three series is studied and the influence of heat treatment described. Part III deals with the removal of antimonial embrittlement by treatment of the melt. Results are discussed in Part IV. Also describes technique of electrolytic polishing of samples for microexaminations. 37 ref.

3-193. **Selection of Cold Work Die Steels.** G. M. Butler. *Machine Tool Blue Book,* v. 42, Oct. '46, p. 135-136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158.

Comparison of various steels generally available for dies for cold work, with emphasis on the properties of each steel which may fit it to some particular need. Includes explanatory tables.

3-194. **Factors Affecting the Hardenability of Boron-Treated Steels.** *Industrial Heating,* v. 13, Sept. '46, p. 1442, 1444, 1446.

Hardenability of four series of plain carbon steels containing 0.40, 0.52, 0.63 and 0.75% carbon respectively, each series prepared by adding graded amounts of boron to adjacent ingots. (Paper by R. A. Grange and T. M. Garvey for American Society for Metals.)

3-195. **Copper and Copper-Base Alloys. (Concluded.)** J. W. Donaldson. *Metal Industry,* v. 69, Sept. 6, '46, p. 195-198.

Stress-corrosion cracking in copper and copper-base alloys. Methods recommended for preventing stress-corrosion cracking include low-temperature annealing, control of precipitation, provision of protective surface films and coatings, and suitable alloying. 16 ref.

3-196. **A Practical Method of Selecting the Correct Type of Cast Iron. Part I.** K. R. Geist and W. A. Hambley. *Iron Age,* v. 158, Oct. 17, '46, p. 64-70.

Melting histories, including mixtures, inoculants, and melting and pouring temperatures, collected at the Allis-Chalmers' plant over the past five years, are correlated with physical properties and chemical analyses.

3-197. **New High-Coercive Alloy "Magnico".** A. S. Ziamovski and L. M. Lvov. *Engineers' Digest (American Edition),* v. 3, Aug. '46, p. 389-391.

Describes attempts to find an alloy which combines high coercive force with high residual induction. By magnetic treatment of nickel alloy of 66 and 78% Ni, permeability can be increased to 350,000 Gauss per Oersted, by quenching in the usual way. Data indicate that the magnetic properties of Magnico alloy containing 12% cobalt can be made to exceed the corresponding properties of Alni by

50%, and this offers considerable advantages when used as material for magnetos, electric generators, etc. Graphs and tables compare properties of various magnetic materials. (Abstract from *Stal,* no. 4, '45, p. 115-120.)

3-198. **A Correlation of Tensile Strength and Drafting for Soft Steel Wire.** Maurice M. Karnowsky. *Wire and Wire Products,* v. 21, Sept. '46, p. 669-672.

A simple, rapid and relatively accurate method of predicting the tensile strengths of straight drawn and processed low carbon steel wires.

3-199. **The Institute of Metals.** *Engineering,* v. 162, Sept. 27, '46, p. 305-307; *Engineer,* v. 182, Sept. 27, '46, p. 281-283.

Abstracts and discussion of the following papers presented at the autumn meeting: "The Hot Tearing Tendencies of Aluminum Casting Alloys", by D. C. G. Lees; "The Application of Some Thermodynamical Principles to the Liquidus Surface of Alloys of Aluminum With Magnesium, Silicon and Iron", by H. W. L. Phillips; "The Aging of a High-Purity, Aluminum Alloy Containing 4% of Copper", by Marie L. V. Gayler; "Control of Internal Stresses in Heat Treated Aluminum Alloy Parts", by L. E. Benson; and "Intercrystalline Corrosion of Aluminum-Magnesium Alloy Rivets", by G. J. Metcalfe. (To be continued.)

3-200. **Mechanism of Creep in Metals.** W. A. Wood and H. J. Tapsell. *Nature,* v. 158, Sept. 21, '46, p. 415-416.

Experiments indicate that a difference in this fundamental process of breakdown of the grains might be a factor distinguishing the normal short-time deformation of a polycrystalline metal in a tensile test with increasing stress, from continuous deformation at the much slower rate known as "creep".

3-201. **Composition and Properties of a Chromium-Tungsten High Speed Toolsteel.** J. A. Heller. *Engineers' Digest (American Edition),* v. 3, Sept. '46, p. 475.

Wide variations encountered in the carbon and chromium contents of the Cr-W steel ZI 184 with 0.8 to 1.0% C, 7.0 to 9.0% Cr, 4.0 to 5.0% W, and 1.1 to 1.5% V, result in considerable differences in the properties of individual heats. Grain growth was found to take place suddenly, depending upon the composition of the high speed toolsteel under consideration. Gives recommendations for composition limits and quenching temperature. (Condensation from *Stal,* no. 1, '45, p. 19-24.)

3-202. **Boron in Steel.** Robert S. Archer. *Metal Progress,* v. 20, Oct. '46, p. 677-686.

First installment is a summary of the knowledge existing as of late 1942, and consists of very full abstracts of "Report on Boron in Steel by the War Metallurgy Committee of the National Academy of Sciences", O.S.R.D. no. 973, Serial M-18. Discusses determination of boron; recovery from scrap; effect of boron on coarsening, on hardenability, on yield point and tensile strength, on hot shortness, on toughness, and on hardness as-rolled; "fading" of boron effect; alloy conservation; ladle vs. mold addition; and the specification problem.

3-203. **A Practical Method of Selecting the Correct Type of Cast Iron. Part 2.** K. R. Geist and W. A. Hambley. *Iron Age,* v. 158, Oct. 24, '46, p. 58-64.

Study of melting histories collected and correlated with physical properties and chemical analyses with the aim of providing the engineer with a practical method of specifying the correct grade of iron for a given section. Method developed enables a foundryman to determine the proper type of iron to meet a given specification.

3-204. **The Physical Properties of a Series of Steels. Part II.** *Iron and Steel Institute Advance Copy,* Sept. '46, 39 p.

A series of 22 steels, comprising eight carbon, eight alloy, and six high-alloy steels was investigated. Electrical resistivity and specific heat measurements were extended so that data are available up to about 1300° C. on all steels, a new method being developed for measurements above 900° C. Determinations of the coefficients of expansion of 14 steels were made, completing the series of steels up to about 1000° C., but excluding the steel of eutectoid composition. Measurements were made of thermal conductivity of a 0.8% carbon steel (steel 7) up to 1000° C. and of a 13% manganese steel (steel 13) up to 350° C. Includes effect of heat treatment on electrical resistivity and thermal conductivity.

3-205. **New Heat Resisting Metals for Engines.** R. K. Winkleblack. *Automotive and Aviation Industries,* v. 95, Oct. 15, '46, p. 40-44.

What design and development engineers can expect of alloys for high-temperature applications in internal combustion engines. Alloys are principally of chromium-nickel-iron, cobalt-chromium, chromium-nickel-cobalt, and chromium-nickel-cobalt-iron bases. Results of tests are summarized. Lists laboratories and companies in which materials were made and tests carried out.

3-206. **Some Notes on Hard Wear Resisting Cast Irons and Steels.** Marcel Ballay and Raymond Chavy. *Foundry Trade Journal,* v. 80, Sept. 19, '46, p. 55-61.

Various solutions are available to the metallurgist in the problem of obtaining a hard cast iron, resistant to wear. Properties of gray and white irons reviewed. Test results from research work on surface renewal by welding with cast irons or hard steels. (Translated from French.)

3-207. **What's New in Alloy Steels?** J. M. Hodge and M. A. Grossmann. *Machine Design,* v. 18, Oct. '46, p. 67-71.

Some new steels and their significance to the designer. Included are "superalloy" steel for high-temperature service, age hardenable stainless steel, alloy plate for built-up welded sections, low-alloy high-tensile steel, and steels designed specifically to retain toughness in low-temperature applications. Emphasizes growing trend toward extending the use of the hardenability concept for steel specifications.

3-208. **The Institute of Metals.** *Engineering,* v. 162, Oct. 4, '46, p. 329-330.

Discussion of paper on "The Resistance to Corrosion by Sea Water of Some α-Tin and α-Tin Aluminum Bronzes", by J. W. Cuthbertson; condensation and discussion of

"Capillary Flow in the Soldering Process and Some Measurements of the Penetration Coefficients of Soft Solders". by A. Latin, and "The Physical Properties and Temper Hardening Characteristics of Copper-Nickel-Manganese Alloys", by Maurice Cook and W. O. Alexander; "Inert Atmospheres as Fatigue Environments", by H. J. Gough and D. G. Sopwith. (Concluded.)

3-209. **Ferrous Metallurgy in Russia. Recent Work on Cast Iron and Alloy Steels.** W. G. Cass. *Chemical Age,* v. 55, Oct. 5, '46, p. 407-410.

Summarizes author's knowledge of recent Russian work as obtained from journal articles and from N. F. Bolkhovitinov's "Physical Metallurgy and Heat Treatment", which latter is outlined chapter by chapter.

3-210. **Chill-Cast Tin Bronzes.** K. Winterton. *Metal Industry,* v. 69, Oct 11, '46, p. 297-299.

Effect of the addition of 2.5 to 10% zinc on the casting characteristics, and mechanical and physical properties of chill-cast tin bronzes (5 to 15% tin). Zinc impairs the soundness and strength of all the bronzes examined and when zinc is present there is no advantage in using a tin content higher than 5 to 7% in chill-cast ingots. 5 ref.

3-211. **Functions of Alloying Elements in Heat Resisting Steels.** Herbert Dobkin. *Steel,* v. 119, Oct. 28, '46, p. 78-79, 106, 108, 111.

Explains some of the fundamentals of the metallurgy of heat resisting alloys; discussion based on wrought 18-8 chromium-nickel stainless steel. Functions of the alloy content of 18-8 and the effect of the modification of this analysis by further alloy additions. Such modifications are the basis for the development of most of the wartime superalloys.

3-212. **Overheating and "Burning" of Steel—Further Considerations.** F. C. Thompson. *Iron and Steel,* v. 19, Oct. '46, p. 551-554.

Extended discussion of papers on this subject presented to the Iron and Steel Institute on May 2, 1946.

3-213. **Thermal Expansion Stresses in Reinforced Plastics.** Philip S. Turner. *Journal of Research of the National Bureau of Standards.* v. 37, Oct. '46, p. 239-240.

A method of compounding a plastic, or other mixture of compositions, to provide a material having a predetermined desired coefficient of thermal expansion. This method makes it possible to produce satisfactory plastic-metal bonds. A formula is developed for calculating coefficients of thermal expansion of mixtures from those of their components, and verified for several metallic mixtures. Applicability is illustrated by behavior of brass inserts in a mixture of styrene, resin and aluminum oxide powder; by application to compositions for filling rivet depressions; and to mixture of phenol formaldehyde resin and glass fibers.

3-214. **The Development of a Turbosupercharger Bucket Alloy.** E. Epremian. *American Society for Metals Preprint,* no. 1, 1946, 13 p.

Alloys under consideration were those having a cobalt base containing chromium, nickel, tungsten, and molybdenum. By varying one constituent at a time within reasonable limits and determining the effect on properties, an optimum alloy composition was obtained. Includes summary of the physical properties which must be considered with data on the most promising alloy developed in this investigation.

3-215. **The Stress Rupture and Creep Properties of Heat Resistant Gas Turbine Alloys.** Nicholas J. Grant. *American Society for Metals Preprint,* no. 2, 1946, 46 p.

Large number of rupture and creep tests at 1500 to 1800° F. and at stresses from 7000 to 15,000 psi. in creep and 15,000 to 35,000 psi. in rupture were made on a series of vitallium-base (cobalt-chromium-molybdenum) and nickel-chromium-cobalt-iron-base alloys. Variables studied were effects of increasing amounts of carbon and nitrogen on the hot strength and ductility of these alloys; the role of heat treatment and aging; the relationship of the stress to the rupture time and to the minimum creep rate measured in both rupture and creep tests. An important relationship was shown to exist between time at temperature and the resultant ductility at fracture.

3-216. **The Apparent Influence of Grain Size on the High Temperature Properties of Austenitic Steels.** C. L. Clark and J. W. Freeman. *American Society for Metals Preprint,* no. 19, 1946, 23 p.

Effect of variations in grain size on high-temperature strength. Four different austenitic steels were considered and their relative high-temperature properties were evaluated on the basis of short-time tensile, creep and stress-rupture tests at temperatures varying up to 1800° F.

3-217. **The Effect of Manganese on the Properties of Cast Carbon and Carbon-Molybdenum Steels.** N. A. Ziegler, W. L. Meinhart, and J. R. Goldsmith. *American Society for Metals Preprint,* no. 27, 1946, 39 p.

Results of an investigation on the effect of manganese on thermal characteristics, microstructures, physical properties and weldability of plain carbon and carbon-molybdenum cast steels.

3-218. **Graphidox as an Inoculant.** *Gray Iron Progress,* v. 3, Oct. '46, p. 3-4.

Gives results of tests on use of Graphidox for the inoculation of high-strength, low-carbon equivalent, alloyed iron. Results show that Graphidox is quite effective in reducing the Brinell hardness of light sections and in increasing the tensile strength, transverse deflection, transverse strength, and impact strength of 1.2-in. diameter test bars.

3-219. **Induction and Dielectric Heating Data, Physical Constants of Metals.** *Tool & Die Journal,* v. 12, Oct. '46, p. 101.

Material; resistivity; temperature, coefficient of resistance; specific gravity; specific heat; coefficient of thermal condition.

3-220. **A Practical Method of Specifying Cast Irons.** K. R. Geist and W. A. Hambley. *Iron Age,* v. 158, Oct. 31, '46, p. 46-49.

Method, employing a simple code, enables a design engineer to quickly and accurately select the grade of iron with the desired characteristics, taking into consideration strength and hardness in the controlling section size.

3-221. **Development of the 16-25-6 Alloy at the Timken Roller Bearing Co.** *Steel Processing,* v. 32, Oct. '46, p. 656-660.

Data on effects of cold working. Results of hardness tests are shown in table and the effect of cold work upon the hardness of hot rolled 16-25-6 illustrated. Physical data given in tables. Graphs show the best treatments used on the alloy, and the resultant physical characteristics.

3-222. **Dissociation Pressures of Metal Oxides Formed on Various Solid Metals.** Benjamin Lustman. *Steel Processing,* v. 32, Oct. '46, p. 669, 676.

Dissociation pressures have been calculated as a function of temperature and are presented and discussed. (Based on data which appeared in a series of papers by K. K. Kelly, *Bureau of Mines Bulletin* 371, 394, and 434.)

3-223. **New Alloys for Severe Corrosion Services.** M. G. Fontana. *Chemical Engineering,* v. 53, Oct. '46, p. 114-115.

Properties of Chlorimet 2, a Ni-Mo alloy and Chlorimet 3, a Ni-Mo-Cr alloy recently put on the market by Duriron Co. They are produced only as castings and are expected to find their biggest use as pumps and valves. Both are machinable and Chlorimet 2 can readily be hardened by heat treatment

3-224. **Boron in Iron and Steel.** R. S. Dean and B. Silkes. *Bureau of Mines Information Circular* 7363, Sept. '46, 56 p.

Review of the literature; methods of adding boron to steel and results of using special addition agents containing boron; details of procedures for determination of boron in iron and steel. Includes graphs and tables showing experimentally determined data on properties of steel as influenced by boron content. 297 ref.

3-225. **Thermal Etching of Silver.** R. Shuttleworth, R. King, and B. Chalmers. *Nature,* v. 158, Oct. 5, '46, p. 482-483.

Phenomenon of development of an etched appearance on the polished surfaces of metal specimens when heated in atmospheres with which chemical reaction is not expected. It was investigated by heating various samples of high purity silver in various atmospheres at 920° C. and in vacuum. A tentative explanation is suggested. 10 ref.

3-226. **High-Strength High-Temperature Alloy S-816.** Thomas Y. Wilson. *Materials & Methods,* v. 24, Oct. '46, p. 885-890.

High strength at 1500° F., resistance to burned fuel gases, and ease of fabrication are among the favorable characteristics of this cobalt-base alloy (44%) containing 20% chromium, 20% nickel, 4% molybdenum, 4% tungsten. 4% columbium, 1.5% max. manganese, 1.0% max. silicon, 0.40% carbon, and 4% max. iron.

3-227. **Standard Steels.** *Materials & Methods,* v. 24, Oct. '46, p. 947.

Properties of basic openhearth and acid bessemer carbon steels; basic openhearth sulphurized carbon steels; and acid bessemer sulphurized carbon steels for hot rolled bars.

3-228. **Outstanding Properties of Magnesium-Zirconium Alloys.** C. J. P. Ball. *Aluminum and Magnesium,* v. 3, Oct. '46, p. 20-21, 41.

Recent work at Magnesium Electron, Ltd., in improving the properties of these alloys, for use in turbines and in aircraft structure.

3-229. **Alloys for High-Temperature Service. Part 1.** W. O. Binder. *Iron Age,* v. 158, Nov. 7, '46, p. 46-52.

Qualifications of metals and methods of evaluating alloys for high-temperature service, comparing prewar alloys with those more recently developed. A study is also made of the effects of various alloying elements in enhancing high-temperature properties.

3-230. **Carbon and Alloy Steel Materials for Hot Formed Springs.** H. C. Keysor. *Product Engineering,* v. 17, Nov. '46, p. 86-89.

Physical and chemical properties of the various steels used in the fabrication of hot coiled springs; proper methods of heat treatment; importance of presetting; effects of the surface conditions of hot coiled springs; conditions of service under which alloy steel is superior to plain carbon steel.

3-231. **The Role of Casting in Engineering Production.** C. R. Austin. *Machinery,* v. 53, Nov. '46, p. 203-207.

Selection of the proper iron in relation to casting section and to mechanical properties demanded; basic engineering properties of the iron in relation to the service demanded; and manner in which these specific properties can be utilized in designing castings. Compares properties of various grades of Meehanite with gray cast iron. (Presented at Fall Meeting of the American Society of Mechanical Engineers.)

3-232. **Weldable Alloy Materials.** *Welding Engineer,* v. 31, Nov. '46, p. 60-81.

Welding qualities and chemical and mechanical properties of 343 ferrous and nonferrous materials.

3-233. **Relation Entre la Chaleur de Fusion et la Temperature Absolue de Fusion des Metaux Monoatomiques. (Relation Between Heat of Fusion and the Absolute Temperature of Fusion of Monatomic Metals.)** Stéfan Procopiu. *Comptes Rendus,* v. 223, Sept. '46, p. 503-504.

It is shown that there is a constant relationship between the above. This value for polyatomic substances is 9.6; for water, 5.4; and for monatomic metals, 1.987. The equation of T. W. Richards may be expressed by $LM/T = R$; in which L = heat of fusion, M = molecular mass, T = temperature of fusion, and R = the gas constant.

3-234. **Creep Strength of Steels.** *Oil and Gas Journal,* v. 45, Nov. 9, '46, p. 103.

Chart shows creep of 16 alloy steels in approximate range 900 to 1400° F.

3-235. **Boron in Certain Alloy Steels.** M. C. Udy and P. C. Rosenthal. *Metals Technology,* v. 13, Oct. '46, T. P. 2085, 29 p.

Results of a systematic survey of the use of boron as an addition to two types of alloyed steels and as a replacement for various percentages of molybdenum in these steels. Both cast and wrought steels of the two basic compositions were prepared. Attention is also given to the effect of boron on other properties of the steels, particularly their notched-bar toughness, to investigate other advantages or limitations of this element as an alloy addition.

3-236. **Hydrogen in Magnesium Alloys.** R. S. Busk and E. G. Bobalek. *Metals Technology,* v. 13, Oct. '46, T. P. 2105, 15 p.

Some facts concerning the solubility of hydrogen in magnesium and its alloys, and their practical significance. Experimental results show that hydrogen dissolves in magnesium to form an interstitial solid solution. Other factors evaluated are: effect of atmosphere on hydrogen content; degassing with chlorine and helium; effect of heat treatment and aluminum and zinc content on hydrogen content; effect of dissolved hydrogen on mechanical properties. Describes apparatus for determining the amount of hydrogen released in the freezing of molten metal. 14 ref.

3-237. **Wrought Copper Alloys With High Silicon.** A. G. H. Anderson. *Metal Progress,* v. 50, Nov. '46, p. 839-843.

Materials and methods used to investigate copper alloys of 4 to 5% silicon. Mechanical properties of hot forged rods, annealed and cold drawn to the per cent reduction indicated. Summary of the relations among the mechanical properties for alloys of varying silicon content and various degrees of cold drawing.

3-238. **The Resistance of Metals to Scaling.** Benjamin Lustman. *Metal Progress,* v. 50, Nov. '46, p. 850-856, 860.

Structure of scales; determination of oxidation resistance; rate of oxidation of various alloys; chromium-iron alloys; chromium-nickel alloys; nickel-chromium-iron alloys; aluminum-iron alloys; aluminum-chromium-iron alloys; silicon-iron and silicon-chromium-iron; copper-base alloys; effect of minor impurities on oxidation resistance; influence of gas atmosphere; oxidation stability of alloys. Appendix gives dissociation pressures of oxides formed on various solid metals. 24 ref.

3-239. **Requirements of Steels for High-Temperature Service.** Claude L. Clark. *Metal Progress,* v. 50, Nov. '46, p. 897-903.

Describes the present situation regarding a series of chromium steels containing from 5 to 9% chromium. Evaluation of high-temperature strength on basis of either rupture or creep strength; if application is one in which temperature rises continuously during operation, rupture strength is most suitable basis; if temperature is constant then creep characteristics serve best.

3-240. **Mild Steel.** H. Markus and D. F. Armiento. *Machine Design,* v. 18, Nov. '46, p. 123-126.

Studies on spheroidized aluminum-killed S.A.E. 1030 steel

in the form of disks, 0.690 in. thickness and 9.225 in. diameter, to determine course of grain coarsening. Chemical composition of the steel is shown in table.

3-241. **Hastelloy Alloys, Wrought and Cast.** *Machine Design,* v. 18, Nov. '46, p. 155-158.

Properties; physical constants; characteristics; applications; fabrication; resistance to corrosion; annealing.

3-242. **Influence of Residual Elements on the Properties of Malleable Cast Iron.** *Foundry Trade Journal,* v. 80, Oct. 10, '46, p. 139-140.

Twenty-three batches of small pigs were cast, from hematite steel-base and from refined iron-base irons, and alloy additions were made in the crucible. All conditions of production were closely standardized, to insure complete comparability of castings. For the study of each element (nickel, copper, molybdenum, titanium, boron, arsenic and phosphorus) a series of four different compositions was made.

3-243. **Properties of Various Alloys at Subzero Temperatures.** *Iron Age,* v. 158, Nov. 14, '46, p. 75.

Investigation to determine the mechanical properties of various ferrous and nonferrous alloys at −320° F. indicated that both tensile and yield strength of all alloys tested are greater at the subzero temperature than at room temperature. Tables summarize the results of the investigation with various alloys, and give a comparison of mechanical properties of seam and arc-welded joints of the various alloys at room temperature and at −320° F.

3-244. **Tantung, What It Is, How to Use It.** D. I. Brown. *Iron Age,* v. 158, Nov. 14, '46, p. 76-81.

Tantalum carbide alloy, precision cast to shape. Discusses how it is produced, its metallurgical and physical properties and how to use it to advantage in machining operations. Data from a number of comparative machining tests are given, and use of alloy for parts where high resistance to corrosion and abrasion is required is also covered.

3-245. **Alloys for High Temperature Service. Part 2.** W. O. Binder. *Iron Age,* v. 158, Nov 14, '46, p. 92-95.

Effects of strain hardening, heat treatment, and grain size control, in enhancing desirable qualities of the various types of alloys for high-temperature service are reviewed, supported by quantitative test data. Also stresses the importance of characteristics such as fatigue endurance, damping capacity and weldability in determining the suitability of the alloys for use at elevated temperatures.

3-246. **Cast Nickel Alloys—Some Important Properties.** Robert S. Burpo, Jr. *Materials & Methods,* v. 24, Nov. '46, p. 1223.

Table lists mechanical, thermal, magnetic and electrical properties of nickel, monel, Inconel and resistance alloy.

3-247. **Molybdenum in Cast Iron.** A. E. McRae Smith. *Alloy Metals Review,* v. 4, Sept. '46, p. 2-7.

Compositions, properties, applications, and production methods for the various forms of molybdenum cast iron alloys.

3-248. **Outstanding Properties of Magnesium-Zirconium Alloys. (Concluded.)** C. J. P. Ball. *Aluminum and Magnesium,* v. 3, Nov. '46, p. 12-13, 15, 19.

Physical properties and microstructure of these alloys made at Magnesium Elektron, Ltd., Manchester, England. Includes specifications of wrought alloys for sheets, extrusion, and high strength forging; and alloys for sand casting and die casting.

3-249. **The Strength of Rivets.** H. M. Henderson. *Engineer,* v. 182, Nov. 8, '46, p. 416-417.

Results of extensive experiments made to determine the strength of rivets before and after driving. Driving was found to result in marked improvement in tensile properties, often making it possible to omit the use of special analysis steel for the rivets.

3-250. **The Significance of Variations in the Tensile Properties in Cast Bronzes.** W. T. Pell-Walpole. *Foundry Trade Journal,* v. 80, Oct. 24, '46, p. 183-188.

Extensive series of researches on the effects of melting and casting conditions on the properties of bronzes and gun metals gives sufficient data to permit a quantitative study of the relations between tensile strength and elongation, and the significance of the wide variations in values which may occur in these materials.

3-251. **Properties of "HT" Type Alloys—a Summary.** Howard S. Avery. *Alloy Casting Bulletin,* Oct. '46, p. 1-9.

Research program of the Alloy Casting Institute at Battelle Memorial Institute has studied this alloy group with reference to the influence of variations in both major and minor elements on the properties of the material. This work is summarized to date.

3-252. **Influence de l'Aluminium sur la Résilience de l'Acier Mi-doux d'Elaboration Electrique aux Etats Moulé et Forgeè. (Influence of Aluminum on the Impact Strength of Forged or Cast Half-Hardened Electric Steel.)** P. Bastien and C. Dubois. *Comptes Rendus,* v. 223, Oct. 28, '46, p. 672-674.

In experiments on acid electric steel containing 0.20% C, 0.60% Mn, 0.35% Si, 0.03% S, and 0.03% P, aluminum was added up to 0.15%. Results showed that in cast steel impact strength decreases with increasing aluminum content, while in forged steel, increased aluminum content results in increase in impact strength up to a maximum at 0.15% Al.

3-253. **Anomalous High-Frequency Resistance of Ferromagnetic Metals.** *Nature,* v. 158, Nov. 9, '46, p. 670-671.

Normally when a magnetic field of greater than a few gausses is applied to a ferromagnetic metal, differential permeability decreases steadily to unity. As the field is increased at wave lengths of 1 to 3 cm., there is a large increase in the product of resistivity and permeability at a certain magnetic field (shown graphically).

3-254. **Reflectivity of Nickel.** *Nature,* v. 158, Nov. 9, '46, p. 672.

Spectral reflectivity of nickel in the visible part of the spectrum over a range of 400° C.

3-255. **Electric Steel Sheets.** J. S. Vatchagandhy and G. P. Contractor. *Iron and Steel,* v. 19, Nov. '46, p. 591-597.

Composition of most commonly used transformer sheets. Watt losses measured for various steels at different annealing temperatures and soaking times. Effects of annealing time and temperatures studied and influence of finishing temperature. (To be concluded.)

3-256. **Plastic Flow of Metals.** J. H. Hollomon and J. D. Lubahn. *Physical Review,* v. 70, Nov. 1 and 15, '46, p. 775.

An equation has been derived connecting the four variables, strain, strain rate, temperature, and stress required for plastic flow. It has important applications to the problem of creep and to the theory of plastic flow.

3-257. **Explosive Mixtures of Water and Methyl Alcohol With Magnesium and Aluminum.** A. A. Shidlovsky. *Journal of Applied Chemistry* (U.S.S.R.), v. 19, no. 4, '46, p. 371-378.

Thermochemical calculations indicate possibility of the existence of a series of new explosive mixtures. Experimental investigation indicates the explosive character of H_2O-Mg, H_2O-Al and CH_3OH-Mg mixtures.

3-258. **New Toolsteel Features Improved Hot Hardness.** *Iron Age,* v. 158, Dec. 12, '46, p. 63.

Brittleness (from the 1.5% carbon present) is avoided by the addition of 5% vanadium, which also increases the hot hardness of the steel. Hot hardness qualities are further improved with proper cobalt content. Machining qualities; precautions to be observed in grinding and heat treatment recommendations.

3-259. **Postwar Steels Offer New Design Opportunities.** Robert S. Archer, *S.A.E. Journal,* v. 54, Dec. '46, p. 22-25, 46.

Various properties which should be used as a guide in the selection of steel for given applications. The guiding principle in development of N.E. steel was that steels of equivalent hardenability could be used interchangeably.

3-260. **Which Cast Steel? Part I. General Properties and Characteristics.** E. J. Wellauer. *Machine Design,* v. 18, Dec. '46, p. 101-105, 182.

Data presented on physical properties are largely the results of production tests on acid electric, basic electric, acid openhearth, basic openhearth, and converter melted steels. Steels were melted and heat treated with foundry production equipment. Properties are shown with the "spread" which occurs, thereby reflecting the variations expected from actual production and testing variables.

3-261. **Physical Properties of Steels.** *Iron and Steel,* v. 19, Nov. 21, '46, p. 751-753.

Physical properties of a number of steels which enter into calculations concerning heating and cooling problems. Table gives chemical composition and initial heat treatment of each member of series of 22 steels.

3-262. **Effect of Changes in Carbides on the Properties of Steel.** J. B. Austin. *Metal Progress,* v. 50, Dec. '46, p. 1191-1195.

Condensation of Campbell Memorial Lecture given at A.S.M. meeting in November. Carbon content in equilibrium with austenite may be less than that correspond-

ing to Fe_3C, the deficiency increasing with temperature. Carbon may be replaced to a limited extent by nitrogen, and iron atoms can be replaced by atoms of other carbide formers which can fit into the cementite structure. These elements tend to concentrate in the carbide phase, altering many of the properties of the steel under certain conditions.

3-263. **Alloy Steels Intermediate in Chromium.** Claude L. Clark. *Metal Progress,* v. 50, Dec. '46, p. 1199-1203.

Sets forth the characteristics steels must possess for satisfactory high-temperature service and indicates how these required properties vary not only in different industries but in different applications within the same industry. More common alloying elements classified. Some of them are suitable for increasing the high-temperature surface stability and others for improving the strength of alloy steel.

3-264. **Hardenability of N.E. 8600 H Steels.** A. L. Boegehold. *Metal Progress,* v. 50, Dec. '46, p. 1220-B.

Chart gives hardness at surface, at half radius and at center, in oil and in water.

3-265. **Some Effects of Zirconium on Extrusion Properties of Magnesium-Base Alloys Containing Zinc.** J. P. Doan and G. Ansel. *Metals Technology,* v. 13, Dec. '46, T. P. 2107, 18 p.

Hot workability, tension and compression properties, metallography, and toughness of these alloys containing 0 to 7% Zn and 0 to 1% Zr. Zirconium has the outstanding effect of greatly increasing the extrudability of Mg-Zn alloys. Properties charted and tabulated. 14 ref.

SECTION IV

STRUCTURE

Metallography and Constitution

4-1. **The Binary Alloys of Indium and Tin.** Colin G. Fink, Eric R. Jette, Sigmund Katz and Frank J. Schnettler. *Electrochemical Society Preprint* 88-15, 1945, 13 pp.

Lattice constant measurements, density measurements, electric conductivity measurements, and thermal measurements. Dissociation temperatures of the intermetallic compounds β and γ found to be 126.5° C. and 124.0° C. respectively. No arrest points detected for the peritectic reaction on the indium-rich side of the compound γ. Eutectic reaction occurs at a liquid composition of 48.5 atom per cent tin and 116.3° C. Both of the intermediate phases, β and γ, are very soft and ductile.

4-2. **Application of X-Ray Analysis of Metallurgical Problems.** M. Paic. *Engineers' Digest (American Edition)*, v. 2, Nov. '45, pp. 547-548.

X-rays absorbed by matter provide useful means for determining chemical heterogeneity of alloys. Underlying principle of method. (From *Revue de Métallurgie*, v. 41, July '44, pp. 169-179.)

4-3. **Recrystallization.** *Metal Industry*, v. 67, Nov. 23, '45, p. 345.

Problem of exaggerated grain growth. 2 ref.

4-4. **The Constitution of the Aluminum-Rich Alloys of Aluminum, Chromium, and Manganese.** G. V. Raynor and K. Little. *Journal of the Institute of Metals*, v. 71, Oct. '45, pp. 493-524.

Very slow rate of attainment of equilibrium noted. Probable that equilibrium in some ranges of composition can only be obtained after annealing treatments of prohibitive length. In view of this, results obtained for solid alloys described in terms of constitutions of the alloys as actually observed after specified annealing treatments, together with deductions which can legitimately be made with regard to equilibrium conditions. 14 ref.

4-5. **Recrystallization, II.** *Metal Industry*, v. 67, Dec. 7, '45, pp. 379-380.

Process of nucleation and grain growth. 2 ref.

4-6. Some Problems of the Metallic State. Lawrence Bragg. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 513-535.

Deals with the structural features which account for the mechanical properties of a metal, with special regard to the elastic limit, for which a tentative theory is put forward. 5 ref.

4-7. Rimming Steel. J. S. Vatchagandhy and G. P. Contractor. *Iron and Steel,* v. 18, Nov. 30, '45, pp. 585-586.

Analytical survey of a tin-bar ingot. 15 ref.

4-8. Iron-Silicon Alloys. Margaret C. M. Farquhar, H. Lipson and Adrienne R. Weill. *Iron and Steel,* v. 18, Nov. 30, '45, pp. 614-618.

X-ray study of the range with low silicon contents.

4-9. Some Factors Affecting Edgewise Growth of Pearlite. W. H. Brandt. *Metals Technology,* v. 12, Dec. '45, T. P. 1857, 12 pp.

Theory; existence of lamellar structure; extrapolations of ferrite and cementite solubilities; effect of carbon content on pearlite growth; effects of alloying elements on pearlite growth and hardenability. 14 ref.

4-10. Young's Modulus—Its Metallurgical Aspects. David J. Mack. *Metals Technology,* v. 12, Dec. '45, T. P. 1936, 14 pp.

Many factors that affect magnitude of Young's modulus examined. Crystallographic effects seem most important because of elastic anisotrophy. Cold working reduces while stress relieving and process anneals tend to increase it. Effect of alloying is directly proportional to amount of alloying element added, provided alloys are in fully annealed condition. Microstructure has little effect unless homopolar compounds are involved, although age hardening and suppressed eutectoidal transformations seem to affect modulus in certain cases. Temperature exerts considerable influence on value of modulus, modulus decreasing with increasing temperature. Degree of magnetic saturation affects modulus of ferro-magnetic materials. Discontinuities in metal, such as cracks, blowholes, or graphite in cast iron, lower modulus considerably. 103 ref.

4-11. Estimation of Spatial Grain Size. William A. Johnson. *Metal Progress,* v. 49, Jan. '46, pp. 87-92.

Four steps are necessary: (1) Estimate the relative area of each size of the grains showing on a micrograph; (2) calculate from this estimate the relative distribution of spatial grains; (3) estimate the average spatial grain size; (4) calculate the standard deviation, employed as a measure of the uniformity of grain size.

4-12. Microstructure Related to Properties of Cast Iron. W. E. Mahin and H. W. Lownie. *American Foundryman,* v. 9, Jan. '46, p. 20-28.

Cast iron microstructures and attendant properties may be changed by quenching and tempering treatments to improve strength and hardness. Alloying elements may be used to develop microstructures of increased strength, hardness, great wear resistance. 7 ref.

4-13. Tessellated Stresses—Part IV. F. Laszlo. *Iron and Steel Institute Advance Copy,* Nov. '45, 22 p.

The criterion of making units of structural tessellation self-compensated is found to be the equality of the shear moduli of elasticity of the components. 10 ref.

4-14. **Constitution of Commercial Low Carbon Iron-Silicon Alloys.** R. L. Rickett and N. C. Fick. *American Institute of Mining and Metallurgical Engineers T. P.* 1966, 1946, 9 p.

The constitution was determined of a series of commercial silicon steels containing 0.05 to 0.08% carbon and 0.20 to 4.1% silicon, over the temperature range 1300° to 2500° F.

4-15. **Grain Size.** *Metal Industry,* v. 68, Jan. 18, '46, p. 53-54.

Application of mathematical analysis to its determination. 1 ref.

4-16. **The Phase Changes of S.A.E. 2345 Steel.** A Dubé and R. L. Cunningham. *Canadian Mining and Metallurgical Bulletin, Transactions Section,* no. 405, Jan. '46, p. 1-21.

Experimental details; heat treatment, dilatometric and magnetic measurements. Experimental results; mechanical properties; magnetic and dilatometric data; metallographic examination; X-ray diffraction; discussion of results. 14 ref.

4-17. **Grain Sizes Produced by Recrystallization and Coalescence in Cold Rolled Cartridge Brass.** Harold L. Walker. *University of Illinois Engineering Experiment Station Bulletin Series,* no. 359, 1945, 58 p.

Experiments and data obtained in distinguishing between the grain sizes produced by true recrystallization and those produced by coalescence.

4-18. **A Preliminary Investigation of the Constitution of Mild Steel Arc Weld Deposits.** H. A. Sloman, T. E. Rooney and T. H. Schofield. *Welding Journal,* v. 25, Jan. '46, p. 39s-52s.

Oxygen, hydrogen and nitrogen contents of mild steel weld deposits laid down under certain standard conditions, and also the form in which oxygen is present, have been determined. Deposits from six different electrodes were found to differ appreciably in their contents of the gaseous elements. Observations connecting these differences with the compositions of the electrode coatings have been made. 4 ref.

4-19. **Grain Boundaries.** R. C. Bernhoeft. *Metallurgia,* v. 33, Jan. '46, p. 117-120.

Various theories evolved from 1929 are reviewed and discussed. 16 ref.

4-20. **Problems in Non-Elastic Deformation of Metals.** Clarence Zener and J. H. Hollomon. *Journal of Applied Physics,* v. 17, Feb. '46, p. 69-82.

"Anelasticity" (elastic after-effect, primary creep) associated with viscous behavior of grain boundaries and temporary viscous behavior of slip bands. Mechanics of the initiation and growth of twin bands. Mechanics of the initiation and growth of slip bands, including drop in resistance to deformation which accompanies initial slip bands. Mechanics of segregation of solute atoms in solid solution, such as of carbon and nitrogen in iron. Condi-

tions under which strain hardening is not removed by recovery or by recrystallization, and hence under which a relation exists between strain rate, strain, stress, and temperature. Variation of heat of activation for plastic strain rate upon stress and upon the microstructure. Anisotropy introduced by deformation. 38 ref.

4-21. **Problems in Fracture of Metals.** J. H. Hollomon and C. Zener. *Journal of Applied Physics,* v. 17, Feb. '46, p. 82-90.

Effects of following variables on virtual fracture stress: *(a)* strain; *(b)* strain rate; *(c)* temperature; *(d)* stress distribution; *(e)* structure; *(f)* mechanical history (i. e., fatigue). Comparison of fracture characteristics of metallic crystals with those of non-metallic crystals. Hindrances of plastic deformation by sharp stress gradients. Introduction of stress concentration by: *(a)* non-metallic inclusions; *(b)* precipitates; *(c)* slip bands; *(d)* twin bands; *(e)* grain boundary deformation. Effect of reversal of stresses upon properties of slip bands. 23 ref.

4-22. **Investigation of Secondary Phases in Alloys by Electron Diffraction and the Electron Microscope.** R. D. Heidenreich, L. Sturkey and H. L. Woods. *Journal of Applied Physics,* v. 17, Feb. '46, p. 127-136.

Application of electron diffraction reflection methods and electron microscope to investigations of metallurgical structures. These instruments can yield valuable information concerning very small amounts of secondary phases and impurities in metals. When martensite decomposes at 200° C., the slow etching component is highly dispersed Fe_3N. Decomposition at 400° C. yields usual Fe_3C. Further, Fe_3N formed at 200° C. transforms to Fe_3C when annealed at 350° C. Surface preparation is discussed and a satisfactory technique for rinsing etched surfaces is described.

4-23. **Equilibrium Relations in Medium Alloy Steels.** Clarence Zener. *Metals Technology,* v. 13, Jan. '46, T. P. 1856, 22 p.

General theory of the equilibrium between two solid phases developed from thermodynamical and statistical mechanical concepts; general theory applied to the equilibrium relations in the iron-carbon system between the alpha-gamma and cementite phases, and to the effects of alloying elements thereon. Method developed for rapidly computing the equilibrium relations in any medium alloy steel. 20 ref.

4-24. **Phase Boundaries in Medium Alloy Steels.** W. A. West. *Metals Technology,* v. 13, Jan. '46, T. P. 1924, 12 p.

Equations make it possible to calculate the effect on the equilibrium concentration of one alloying element due to the presence of one or more other elements. They give for alloys steels, the carbon concentrations in alpha and gamma with each other, and in gamma in equilibrium with cementite; may be modified for use for carbon-free alloys. Summary given of the equations used in analyzing the data. 27 ref.

4-25. **Kinetics of the Decomposition of Austenite.** Clarence Zener. *Metals Technology,* v. 13, Jan. '46, T. P. 1925, 34 p.

Review of kinetics of austenite decomposition; deals with the kinetics of phase transformations. New theory regarding martensite formation. 39 ref.

4-26. **Atomic Structure of Steels.** Audrey M. B. Parker. *Steel,* v. 118, Feb. 25, '46, p. 89-91, 127.

Method of X-ray analysis is peculiarly suited for determination of atomic structures of different phases present in steels. 6 ref.

4-27. **Solid Solutions.** I. I. Kornilov. *Iron and Steel,* v. 19, Feb. '46, p. 52-56.

Solubilities of elements in iron in the solid state from the point of view of Hume-Rothery's size factor theory. The size factor alone is adequate to account for the experimental results except in the case of cerium and certain elements of the B sub-groups of the fourth and fifth periods of the periodic system. (Translated from Izvest. Akad. Nauk, U.S.S.R. (Khim), v. 2, 1945, p. 104, by G. Stanley Smith.)

4-28. **Constitution of Commercial Low Carbon Iron-Silicon Alloys.** R. L. Rickett and N. C. Fick. *Metals Technology,* v. 13, Feb. '46, T.P. 1966, 9 p.

Constitution was determined of a series of commercial silicon steels containing 0.05 to 0.08% carbon and 0.20 to 4.1% silicon, over the temperature range 1300 to 2500° F. These alloys were all from regular production heats and of commercial quality. Results of the tests are given and for comparison the constitution diagram of iron-silicon alloys with 0.01 to 0.02% carbon is also presented. 4 ref.

4-29. **The Solubility of Hydrogen in Molten Iron-Silicon Alloys.** Hung Liang, Michael B. Bever and Carl F. Floe. *Metals Technology,* v. 13, Feb. '46, T.P. 1975, 9 p.

Results of an investigation of the solubility of hydrogen in representative compositions of the iron-silicon system up to 65% silicon at temperature ranging from above the liquidus to 1650° C. and at one atmosphere pressure. 17 ref.

4-30. **Some Questions That Can Be Answered by X-Ray Diffraction.** Charles S. Barrett. *Industrial Radiography,* v. 4, Winter, '46, p. 12-18.

Phase diagram determination and studies of the effects of deforming and heat treating metals.

4-31. **Metallurgical Aspects of Machinability.** F. J. Robbins. *Iron Age,* v. 157, March 21, '46, p. 42-47.

Effects of varying amounts of carbon, sulphur, manganese, lead, and sodium bisulphite, with particular relation to their effect on microstructure and consequent effect on machinability.

4-32. **Metallurgical Aspects of Machinability. Part 2.** F. J. Robbins. *Iron Age,* v. 157, March 28, '46, p. 47-51.

Microstructure of alloy steels is discussed in relation to machinability, with special emphasis on the effects of spheroidization. Effects of grain size are also considered, as well as the results obtained by resulphurizing and by the addition of sodium bisulphite.

4-33. **Importance and Factors Determining the Grain Size of Magnesium Castings.** L. W. Eastwood and James A. Davis. *Aluminum and Magnesium,* v. 2. March '46, p. 14-17.

Grain size of light sections of magnesium castings, perhaps up to ¾ in. thick, is substantially unaffected by pouring temperature over a range of 1500 to 1300° F. In some instances, pouring temperature of 1250° F. causes an increase in grain size. Where solidification is slow, or in heavier sections, the grain size is markedly increased with increasing pouring temperature, the finest grains being obtained at a pouring temperature of about 1300° F. Coarse grain tends to accentuate microporosity slightly, and very slight increases in grain size are accompanied by a markedly increased susceptibility to hot cracking. 12 ref.

4-34. **Some Notes on Graphitization.** Lester Crome. *Foundry,* v. 74, April '46, p. 98-101, 232.

Effect of chills studied, using an iron responsive to the low-temperature pre-anneal heat treatment. First a bar 1¼ x 2 x 12 in. was cast with half its length on a chill ⅝ x 2 x 6 in. It was given 3 hr. at 600° F., air cooled, and then an over-all malleableizing cycle of 15 hr. End not chilled had a normal black fracture. Next, different sections were tried with different size chills producing results which are summarized.

4-35. **The Lead-Aluminum Diagram.** *Light Metals,* v. 9, April '46, p. 220-222.

Experiments show that lead with 0.025% aluminum gives a eutectic melting at 326.2 ± 0.1° C., and that the solubility of aluminum in liquid lead increases with rising temperature. No solid solution of aluminum in lead exists.

4-36. **Steel Susceptibility to Hot-Tear Formation in Castings.** N. B. Gelperin. *American Foundryman,* v. 9, April '46, p. 161-163.

Various steels under the same conditions are quite different in their susceptibility to hot-tear formation. This susceptibility is essentially influenced by the allotropic transformation of delta phase into gamma phase that takes place in most kinds of steel during the cooling of castings.

4-37. **Structure Control of Gray Cast Iron—Part III.** R. G. McElwee and Tom E. Barlow. *Vancoram Review,* v. 4, Fall-Winter '45-46, p. 7-9, 21.

Effects of temperature, time and melting practice on properties of inoculated metals.

4-38. **Electron Metallographic Methods and Some Results for Magnesium Alloys.** R. D. Heidenreich, C. H. Gerould and R. E. McNulty. *Metals Technology,* v. 13, April '46, T.P. 1979, 22 p.

A new etching (methyl iodide) and rinse procedure has been developed for magnesium alloys, which yields, in contrast to standard etchants, a surface free of film and mechanical distortion. The surface resulting from this etchant may be examined in the electron microscope by use of the polystyrene-silica replica technique, or by re-

flection electron diffraction methods. Gives results that are not only consistent with those observed in the light microscope, but also much additional detail. 10 ref.

4-39. **Effect of Copper and Some Other Metals on the Gold-Germanium Eutectic.** Robert I. Jaffee and Bruce W. Gonser. *Metals Technology,* v. 13, April '46, T.P. 1998, 8 p.

Investigates effect of third components on the melting point, microstructure, and strength of this alloy. Effect of copper is discussed rather completely, with less complete data on the effects of silver, platinum, nickel, and zinc.

4-40. **Microstructure Related to Properties of Cast Iron.** W. E. Mahin and H. W. Lownie, Jr. *American Foundrymen's Association Preprint* 46-37, 1946, 9 p.

Most of the discussion is concerned with the microstructure of cast irons which are "gray" when sand-cast in moderately thick or heavy sections. The microstructure of gray cast iron usually is made up of a matrix similar to that of steel, consisting of all or part of the constituents pearlite, ferrite, and massive cementite, and, in addition, containing flakes of graphite.

4-41. **Theories of Gray Cast Iron Inoculation.** H. W. Lownie, Jr. *American Foundrymen's Association Preprint* 46-39, 1946, 7 p.

Inoculation may be defined as that process in which an addition is made to molten cast iron for the purpose of altering or modifying the microstructure of the iron and thereby improving the mechanical and physical properties to a degree not explainable on the basis of the change in composition.

4-42. **Theory of the Elastic After-Effect and the Diffusion of Carbon in Alpha Iron.** D. Polder. *Philips Research Reports,* v. 1, Oct. '45, p. 5-12.

Snoek's theory of the elastic after-effect in α-iron, which ascribes this effect to the internal migration of dissolved carbon or nitrogen atoms, is worked out in more detail. The effect is calculated when a single crystal is submitted to a simple stress in an arbitrary direction and the result is compared with the experimental values. The agreement is satisfactory. From the time of relaxation, by means of which the relaxation phenomena in a state of alternating stress can be described, the coefficient of diffusion of carbon in α-iron is calculated and the numerical value is compared with that of γ-iron.

4-43. **Order-Disorder Transformations. I.** *Metal Industry,* v. 68, April 26, '46, p. 333-334.

Clarification of their metallurgical effects.

4-44. **Physical Metallurgy.** R. Hultgren and E. R. Parker. *Metal Industry,* v. 68, May 10, '46, p. 371-374.

Some interesting advances in nonferrous physical metallurgy during 1945 and earlier war years. Progress in the application of X-ray diffraction and electron diffraction methods to the study of metallic structure.

4-45. **Order-Disorder Transformations—III.** *Metal Industry,* v. 68, May 24, '46, p. 415.

Table gives binary systems in which order-disorder

transformations have been observed. Application in copper-manganese-nickel alloy as substitute for beryllium copper.

4-46. **A Review of the Steel Standardization Group's Method for the Determination of Critical Points of Steel.** *Metal Progress,* v. 49, June '46, p. 1169-1171.

Revised procedure of the dilatometric test. Precautions in interpreting data for steels whose S-curve has a double loop.

4-47. **The Vapor Phases of Metals.** R. C. Vickery. *Metallurgia,* v. 34, May '46, p. 4-7.

Thermodynamical basis of metals distillation is surveyed, together with other aspects of applications of metals vaporization. The industrial possibilities are collated and data given on most important physical properties of the more common metals.

4-48. **Russian Metallography.** G. Stanley Smith. *Metal Industry,* v. 68, June 7, '46, p. 451-454.

Principles underlying Russian work on metallic systems with particular reference to the investigations carried out by Kurnakov and his school.

4-49. **The Formation of Banded Structures in Horizontal Centrifugal Castings.** *Foundry Trade Journal,* v. 79, June 6, '46, p. 135-137, 143.

Contribution to the discussion of paper by H. O. Howson read before the Sheffield branch of the Institute of British Foundrymen and published in the Feb. 21st issue of the *Journal.*

4-50. **Grain-Growth Inhibitors in Steel.** James W. Halley. *Metals Technology,* v. 13, June '46, T. P. 2030, 11 p.

The three elements, Al, Ti, Zr differ in type as well as in degree of grain-inhibiting tendency. Aluminum is most effective as a grain-growth inhibitor when 0.028% as acid-soluble aluminum is present. The simple relation between titanium content and coarsening temperature indicates that the mechanism of grain-growth inhibiting by titanium is much less complex than that of aluminum. Zirconium is less effective than either aluminum or titanium as a grain refiner. The improvement in notched impact resistance at low temperatures by these elements is more of a direct alloying effect than the result of grain refinement. Considering the alloying effects alone, aluminum and zirconium are beneficial to low-temperature impact resistance, and titanium is detrimental.

4-51. **Russian Metallography—Discussion of Berthollide Phases.** G. Stanley Smith. *Metal Industry,* v. 68, June 21, '46, p. 495-498.

Capability of berthollides to change their properties as equilibrium conditions alter is of importance in connection with dispersion hardening. Study assists in the choice of suitable age hardening alloys such as occur in the Al-Mg, Al-Cu and Al-Mg-Zn systems.

4-52. **Recrystallization and Coalescence.** *Metal Industry,* v. 68, June 21, '46, p. 499.

Recent work on cold rolled cartridge brass.

4-53. **Atomic Physics and the Strength of Metals.** N. F. Mott. *Engineer*. v. 181, May 24, '46, p. 469-470.

Brief review of theory of dislocations and the attempts which have been made to account for slip in metal. (Paper for Institute of Metals.)

4-54. **Graphitizing Elements in Malleable Cast Iron.** Harry A. Schwartz. *Foundry Trade Journal*, v. 79, June 13, '46, p. 162-163.

Atomic weight or size; mechanical properties; tables give elements hindering graphitization; elements favoring graphitization. (Abstract of paper for American Foundrymen's Association.)

4-55. **The Origin and Constitution of Certain Nonmetallic Inclusions in Steel.** J. R. Rait and H. W. Pinder. *Iron and Steel Institute Advance Copy*, June '46, 28 p.

The phase diagrams relating to the study of nonmetallic inclusions in steel are reviewed, and the important ternary system MnO-Al_2O_3-SiO_2 examined; the most probable phases occurring in the complex system CaO-MgO-FeO-MnO-SiO_2-Al_2O_3 are described in the light of the review.

4-56. **Atomic Physics and the Strength of Metals.** N. F. Mott. *Engineering*, v. 161, June 14, '46, p. 358-360.

Theory of dislocations and the attempts that have been made along these lines to account for slip. (Paper for Institute of Metals.)

4-57. **Russian Metallography—Electron-Atom Characteristics of Phases.** G. Stanley Smith. *Metal Industry*, v. 68, June 28, '46, p. 516-518.

Modern ideas on electron-atom ratios and characteristics as formulated by Hume-Rothery and others compared to Kurnakov's views of chemical combination. Parallelism of two schools of thought demonstrated.

4-58. **Some Observations on the Effect of Oxygen on Carbon in Steel.** Leslie Fine and Charles H. Maak. *Welding Journal*, v. 25, May '46, p. 283s-287s.

A drop in hardness occurs in the weld plane of as-welded oxy-acetylene pressure welds made of low-alloy medium-carbon steels under deliberately poor welding conditions. The alkaline chromate etch has shown evidence of considerable dissolved oxygen in such welds. With this in mind, further investigation of the effect of oxygen upon the behavior of carbon in steel was carried on and the evidence is herein presented.

4-59. **Equilibrium of Iron-Carbon Alloys With Mixtures of CO-CO_2 and CH_4-H_2.** Rodney P. Smith. *Journal of the American Chemical Society*, v. 68, July '46, p. 1163-1175.

By determination of the carbon content of an iron phase which has been definitely equilibriated with one of a series of gas mixtures, each of constant composition, the following equilibria were measured: CH_4-H_2 mixtures with ferrite at 750 and 800°, with austenite at 800 and 1000°, and with graphite at 800 and 1000°; CO-CO_2 mixtures with austenite at 800, 1000, and 1200°, and with graphite at 800 and 1000°. The limiting solubility of carbon in ferrite at 750 and 800° was found to be 0.020 and 0.0128

weight per cent, respectively, both of which are lower than the data commonly accepted hereto. Austenite at its lower limit of stability at 800° contains 0.319 ± 0.004% carbon, in good accord with the results of dilatometric measurements.

4-60. **Fractographic Structures in Bismuth.** Carl A. Zapffe. *Metal Progress,* v. 50, Aug. '46, p. 283-286.

Earlier cursory examination of cleavage patterns of bismuth is expanded to show certain unusual structures in more detail, and their interrelationships indicate following order of development during fracture by impact: twin bands, representing preliminary plastic deformation; secondary cleavages, representing incomplete separation along a prismatic or pyramidal plane family at the time of complete separation on the basal plane of primary cleavage; fissures, representing separation in varying degree up to completeness along some type of intragranular boundaries, probably lineage boundaries; striae, which are fine geometric markings of unknown origin overlying as a triangular matte the entire cleavage facet. In addition there is the primary cleavage plane, or plane of observation, and there are other markings expressing inherent nonuniformities of the crystal.

4-61. **The Martensite Transformation.** A. R. Troiano and A. B. Greninger. *Metal Progress,* v. 50, Aug. '46, p. 303-307.

Describes the known salient characteristics of the martensite transformation and shows how it differs basically from the process of transformation by nucleation and growth. The martensite transformation is without diffusion of elements and involves no change in chemical composition. It progresses only while the specimen is cooling, whereupon more and more discrete volumes of the parent solid solution suddenly transform. The transformation ceases if the temperature drop is interrupted. The martensite transformation for a given alloy cannot be suppressed nor can the temperature of its beginning be depressed by the maximum cooling velocity obtainable.

4-62. **Atomic Physics and the Strength of Metals.** N. F. Mott. *Metal Treatment,* v. 13, Summer '46, p. 119-126.

Account of main contributions of wave mechanics to the physics of metals, stressing limitations of theory in helping the practical man. Illustrates the methods of theoretical physics by a theory of oxidation of metals, and by some remarks about the dislocation theory of slip. In the theory of oxidation, it is shown that when a metal with a thin oxide layer is exposed to air, a constant voltage is set up across the layer, and that growth is usually due to the migration of metal ions through it. The rate of migration is in certain circumstances strongly dependent on the field, so that oxidation practically ceases at a certain thickness. Some new points about the dislocation theory of slip are brought forward. 18 ref. (May Lecture, Institute of Metals.)

4-63. **Oscillating Crystal X-Ray Method Applied to Orientation Relationships.** A. G. Guy. *General Electric Review,* v. 49, Aug. '46, p. 28-32.

Many reactions occurring in solid metals are associated with the production of orientation relationships. A few of these are phase changes, age hardening, recrystallization and the hardening of steel. The oscillating crystal method places an additional technique at the disposal of the investigator in his effort to obtain a complete solution to his problem. Geometrical aspects of crystal structure and its determination; designations and indices of characteristic structures; oscillating crystal method used for obtaining X-ray patterns.

4-64. **X-Ray Analysis.** *Metal Industry,* v. 69, Aug. 2, '46, p. 87-90.

Developments during the war years discussed at the international conference on X-ray analysis organized by the Institute of Physics and held recently at the Royal Institution. Electron microscope; thermal and other perturbations of crystal structures; French X-ray research; crystal chemistry of rare earths; "bubble rafts" for illustrating plane close-packed crystal structures; investigation of slip; Dutch, Belgian and German research.

4-65. **Industrial Application of X-Ray Diffraction.** Elizabeth E. Steffes. *Industrial Radiography,* v. 5, Summer '46, p. 20-23.

Problems requiring general study of crystal orientation, grain growth, or condition of stress can be solved without complicated formulas or precise mathematics by application of basic principles of diffraction. Includes definition of diffraction, methods for making an exposure and examples showing how internal conditions manifest themselves on film. An interesting application to a definite problem in industry is included.

4-66. **The Sigma Phase in Certain High-Chromium Steels.** Francis B. Foley. *Metallurgia,* v. 34, July '46, p. 139-145.

Hard, brittle and non-magnetic constituent formed in certain high-chromium steels is known as the sigma phase. Its formation in appreciable amounts will cause an alloy steel to lose its ductility to such an extent that the usefulness of the steel may be seriously impaired. An up-to-date history and compilation of important results obtained in studies of the occurrence of this brittle constituent in heat resistant alloys.

4-67. **The Structure of Nickel-Aluminum Magnet Alloys and the Control of Brittleness.** Alan Torry. *Metallurgia,* v. 34, July '46, p. 147-153.

Following a historical survey of the cause of high coercivity in the ternary alloys of nickel, iron, and aluminum, an attempt is made to show how the factors responsible for coercivity are also associated with a weak intergranular structure. Excessive brittleness in these alloys may be directly attributed to the differences in the rates of contraction or expansion of the phases already present or being precipitated. Study of the thermal dilatation of Alni, Alnico and Alcomax alloys of varying compositions revealed the magnitude of the influence of such elements as aluminum, copper, and titanium in causing departure from uniform expansion or contraction, both after casting and in subsequent heat treatment.

4-68. **Internal Oxidation of Alloys—I.** *Metal Industry,* v. 69, Aug. 16, '46, p. 139.

In certain conditions oxygen may diffuse inward through some metals and alloys and this action may produce some interesting and important effects. Formation of subscales in alloys of copper and silver; conditions necessary for formation of subscale. 3 ref.

4-69. **Nonmetallic Inclusions in Steel.** J. R. Rait and H. W. Pinder. *Engineering,* v. 162, Aug. 9, '46, p. 141-144.

Concerned mainly with the effect of aluminum as a deoxidant and for grain size control, and the extraneous inclusions brought about by slag and refractory contamination. Considers phase diagrams of the relevant oxide systems. Results of experimental investigation of the MnO-Al_2O_3-SiO_2 system are presented. Identification of phases was by the X-ray powder method. The quaternary system CaO-MgO-SiO_2-Al_2O_3 and its component systems are discussed. (Paper for Iron and Steel Institute.)

4-70. **Nonmetallic Inclusions in Steel. (Concluded.)** J. R. Rait and H. W. Pinder. *Engineering,* v. 162, Aug. 16, '46, p. 165-167.

Constitution of nonmetallic inclusions was elucidated by the application of available phase-diagram data, X-ray powder examination of mechanically extracted inclusions, X-ray and chemical analyses of residues, and microscopic examination. (Paper for Iron and Steel Institute.)

4-71. **The Structure of Tempered Martensite.** W. J. Wrazej. *Iron and Steel Institute Advance Copy,* July '46, 6 p.

X-ray examination of quenched samples tempered at 100° C. for 24 hr. showed that martensite changes on tempering into ferrite and cementite, the latter being precipitated as particles of primary size (multiples of a unit cell) and shape (plates). Owing to the difference between the ferrite and cementite phases in both structure and parameter there will be internal stresses in tempered martensite. These, together with the small particle size, cause the broadening of the lines on the X-ray photographs as evidenced by calculations. Martensite can be tempered even at a temperature as low as 100° C., the first stage of troostite being formed. 11 ref.

4-72. **The Neutralization of Sulphur in Cast Iron by Various Alloying Elements.** H. Morrogh. *Iron and Steel Institute Advance Copy,* July '46, 10 p.

Metallographic examination made of sulphide phases in irons of low manganese and high sulphur contents to which varying amounts of nickel, molybdenum, copper, chromium, and aluminum have been added. Includes description of melting and testing procedure; 31 photomicrographs. 20 ref.

4-73. **Effect of Original Orientation on Orientation Changes During Recrystallization in Silicon Ferrite.** C. G. Dunn. *Metals Technology,* v. 13, Aug. '46, T. P. 1990, 15 p.

Continuation of the work on recrystallization in silicon ferrite extended to include five original orientations and higher percentages of cold reduction. Presents data on

changes of orientation due to recrystallization and discusses them from an analytical viewpoint.

4-74. **Some Aspects of Crystal Recovery in Silicon Ferrite Following Plastic Strains.** C. G. Dunn. *Metals Technology,* v. 13, Aug. '46, T. P. 1991, 22 p.

Restoration of the properties of a metal by heat treating after plastic deformation is known as recovery. Type of recovery which reduces spread in grain orientation over relatively large regions (larger than 10^{-4} cm.) is investigated. Topics covered are: Results of cold reduction and subsequent annealing on single, double, and complex lattice types; effect of Neumann bands on distortion and recovery; recovery and growth of deformed grains; effect of time and temperature on recovery; effect of recovery on rate of growth; crystal distortion and recovery in a recrystallized matrix. Illustrated by Laue photographs. 12 ref.

4-75. **Anisothermal Decomposition of Austenite.** J. H. Hollomon, L. D. Jaffe, and M. R. Norton. *Metals Technology,* v. 13, Aug. '46, T. P. 2008, 21 p.

Outlines the principles that govern the relations between isothermal and anisothermal decomposition of austenite, presents and systematizes the available experimental information, and indicates the gaps in existing knowledge.

4-76. **A Redetermination of the Lattice Constant of Lead.** Harold P. Klug. *Journal of the American Chemical Society,* v. 68, Aug. '46, p. 1493-1494.

Best value for the lattice constant of lead at $25 \pm 0.1°$ was found to be 4.9408 ± 0.0001 kX units.

4-77. **Neumann Bands and the Planar-Pressure Theory of Hydrogen Embrittlement.** Carl A. Zapffe. *Iron and Steel Institute Advance Copy,* Aug. '46, 8 p.

Study of Neumann bands in ingot iron and in silicon ferrite with the new micrographic technique known as fractography. Passage of hydrogen gas through these irons is studied both before and after deformation by observing the effusion of the gas under oil. Observations provide proof that not only Neumann bands but also slip lines are based on and located by a pre-existent "planar imperfection structure" which must hereafter be considered in all studies of mechanical deformation, and also of chemical precipitation.

4-78. **Dissociation Reactions Within Inclusions.** Carl A. Zapffe. *Iron and Steel Institute Advance Copy,* Aug. '46, 5 p.

Two types of fine-scale phenomena operating within nonmetallic inclusions which in some cases have an important effect on the metal. Intrinsic reactions (the first type) are based upon the existence of low-valence nonmetallic forms at steel-melting temperatures. Extrinsic reactions (the second type) involve included phases which are chemically interdependent with the matrix and are therefore not isolated in a thermodynamic sense.

4-79. **Internal Friction and Plastic Extension of Zinc Single Crystals.** Thomas A. Read and E. P. T. Tyndall. *Journal of Applied Physics,* v. 17, Sept. '46, p. 713-720.

Data on the internal friction of four single crystals of zinc while oscillating longitudinally, and a description of various slow speed tension tests on a fifth crystal within and beyond the elastic limit.

4-80. **Effect of Structural Changes in Steel on Fatigue Life of Bearings.** *Steel,* v. 119, Sept. 30, '46, p. 68-70, 97, 99-100.

Reports metallographic observations of subsurface changes in structure and their effect on fatigue life of higher carbon and higher alloy steels used in completely hardened martensitic state and subjected to compressive loads.

4-81. **Alpha-Gamma Transformation in Iron-Carbon Alloys.** *Nature,* v. 158, Aug. 31, '46, p. 308-309.

Experiments based on microscopic and X-ray analysis of quenched hypo and hypereutectoid alloys, indicate existence of three distinct austenite pseudophases. Experiments with various iron-carbon alloys quenched in various ways tend to show that the amounts of ferrite, martensite and retained austenite obtained in the quenched specimen are independent of the quenching rate so long as a certain rate is exceeded.

4-82. **Studies on the Polymorphic Transformation of Selenium.** C. A. Escoffery and S. Halperin. *Electrochemical Society Preprint* 90-7, '46, 11 p.

The various allotropic modifications of selenium are reviewed. Phase change from amorphous to crystalline hexagonal form and the effect of heat treatments in the manufacture of selenium rectifiers. Photomicrographs of selenium at various stages of grain growth.

4-83. **Iron-Nitrogen, Iron-Carbon and Iron-Carbon-Nitrogen Interstitial Alloys: Their Occurrence in Tempered Martensite.** K. H. Jack. *Nature,* v. 158, July 13, '46, p. 60-61.

Summarizes results of investigations of the three systems, carried out over two years, for the British Iron and Steel Research Association.

4-84. **Internal Oxidation of Alloys—II. The Effect of Formation of Subscales.** *Metal Industry,* v. 69, Aug. 30, '46, p. 181.

Effects of subscales are to act as blocking agents which hinder grain growth when the material is annealed in air; occasionally to produce shallow surface hardening; and to give rise to hydrogen embrittlement when the material is annealed in a reducing atmosphere.

4-85. **Summary Report on the Joint E. E. I.—A. E. I. C. Investigation of Graphitization of Piping.** S. L. Hoyt, R. D. Williams, and A. M. Hall. *Transactions of the American Society of Mechanical Engineers,* v. 68, Aug. '46, p. 571-577; discussion 578-580.

Following failure in Jan. 1943 of a welded joint in a high-pressure steam line at the Springdale Station of the West Penn Power Co., among the several investigations undertaken, a research program was initiated at Battelle Memorial Institute to study the fundamental causes of graphitization and the restoration of graphitized joints. Summarizes findings to date on graphitization and includes not only work of the Institute but elsewhere. Pres-

ent status of significant points which have emerged in relation to manufacture and fabrication.

4-86. **Studies on Susceptibility of Casting Steels to Graphitization.** J. J. Kanter. *Transactions of the American Society of Mechanical Engineers,* v. 68, Aug. '46, p. 581-586; discussion p. 586-587.

Certain aspects of the graphitization problem applying to the carbon-molybdenum casting steels used in welded piping structures. Steels are the types covered in A. S. T. M. Specifications A217 covering pressure alloy castings suitable for fusion welding such as valves, flanges, fittings, and other pressure-containing parts for high-temperature services.

4-87. **Comparative Graphitization of Some Low-Carbon Steels With and Without Molybdenum and Chromium.** G. V. Smith, S. H. Brambir, and W. G. Benz. *Transactions of the American Society of Mechanical Engineers,* v. 68, Aug. '46, p. 589-595.

Study of several experimental heats of steel containing 0.5% molybdenum and up to 1.20% chromium showed that in steels containing 0.5% or more of chromium no graphitization occurred in 3000 hr. at 1025° F. Finding requires confirmation by study of additional heats. Additional studies relating to the effect of deoxidation practice and the effect of post treatment of welds on graphitization are described.

4-88. **Further Observation of Graphitization in Aluminum-Killed Carbon-Molybdenum Steel Steam Piping.** R. W. Emerson and Mathew Morrow. *Transactions of the American Society of Mechanical Engineers,* v. 68, Aug. '46, p. 597-607.

"Slip-plane" graphitization describes a condition of graphite segregation along slip planes where local "yielding" or localized plastic deformation had previously occurred. "Nodular" graphite segregation whether of the "isotherm" or slip-plane type is as effective as "chain" graphite in reducing the ductility of low-carbon or low-carbon-molybdenum steel. 22 ref.

4-89. **Graphitization in Some Cast Steels.** A. J. Smith, J. B. Urban, and J. W. Bolton. *Transactions of the American Society of Mechanical Engineers,* v. 68, Aug. '46, p. 609-620; discussion p. 620-624.

Field service and controlled laboratory experiments have demonstrated that it is not possible to insure against graphitization of carbon-molybdenum steel through any of the controlled procedures of melting and deoxidation practice or heat treatment. Freedom from graphitization is to be sought through use of alloy additions which confer greater stability to the carbide. Hypothesis put forth concerning mode of graphitization based upon observed graphitization behavior of both plain carbon and carbon-molybdenum steels. Use made of this hypothesis to explain resistance to graphitization of the nickel-chromium-molybdenum steels. 14 ref.

4-90. **Grain Boundary Penetrations by Liquid Metals. Part I. Some Service Failures.** W. R. Smith and P. E. J. Forsyth. *Metallurgia,* v. 34, Aug. '46, p. 186-188.

Grain boundary penetration destroys the intercrystalline cohesion of an alloy resulting in premature failure. Some examples of penetration in copper, aluminum, and ferrous alloys are discussed.

4-91. **Inverse Segregation in Cast Magnesium Alloys.** R. J. M. Payne. *Journal of the Institute of Metals,* v. 72, Aug. '46, p. 565-578; discussion p. 578-581.

Use of coarse-grained metal, low casting temperatures, and severe chilling are all conducive to the occurrence of inverse segregation. In segregating, aluminum (8 to 10%) is generally accompanied by other elements present as minor alloying additions or as impurities; silicon in particular, which is present in the alloy as magnesium silicide, may be strongly segregated at the surface of the casting and make its presence manifest by its bright blue color. Magnesium alloy cast under controlled conditions can behave in two ways, exhibiting or failing to exhibit inverse segregation effects according to its grain size; significance of this observation is briefly discussed.

4-92. **Radiocolloid Aggregates in Uranium Minerals.** Herman Yagoda. *American Mineralogist,* v. 31, Sept-Oct. '46, p. 462-470.

Radiocolloid aggregates have been observed in the alpha ray pattern of altered uranium minerals. Properties of laboratory prepared radiocolloids suggest that the naturally occurring aggregates were probably composed of radium sulphate at the time of deposition. The radiocolloids exhibit at present an alpha ray activity about 50 times greater than that of normal uraninites. Their present day composition is essentially $Pb^{206}SO_4$ with about 0.003% $RaSO_4$ as deduced from chemical and radiographic tests. This represents a 150-fold concentration of radium over that normally present in equilibrium with uranium.

4-93. **Distortion Bands in Light Alloy Pressings.** G. A. Knight and G. Murray. *Sheet Metal Industries,* v. 23, Sept. '46, p. 1741-1745, 1755.

General properties of aluminum alloys containing 3% magnesium; stretcher-strain markings in mild steel; surface irregularities; roller leveling; the load-elongation curve characteristics; mechanism of the formation of distortion bands; influence of grain size; need for further work by the industry.

4-94. **Decomposition of Austenite.** *Industrial Heating,* v. 13, Sept. '46, p. 1448, 1450, 1452, 1454.

Microstructure of steel determines its physical properties, and the ultimate structure existing in steel is determined by factors related to the decomposition of austenite into ferrite and carbide during cooling from elevated temperatures. (A general summary of some of the topics covered by round table discussion at recent National Metal Congress, Cleveland.)

4-95. **The Temperature Range of Martensite Formation. (Data Sheet.)** *Metal Progress,* v. 50, Oct. '46, p. 676B.

Explanatory notes given for using scales to determine M_s point.

4-96. **Grain Boundary Penetrations by Liquid Metals. II.** P. E. J. Forsyth and W. R. Smith. *Metallurgia,* v. 34, Sept. '46, p. 245-246.

Two forms of lead attack experienced on sparking plug electrodes made from platinum alloy wire are the general alloying attack and the grain boundary attack, both of which have been observed by microscopic examination of electrodes which have failed under severe service conditions.

4-97. **Carbide Analysis.** *Metallurgia,* v. 34, Sept. '46, p. 287, 289.

Iron carbide in a highly dispersed form is produced during the process of plastic deformation of quenched steel. Since the quantity of carbide formed increases with the deformation it is possible to study the degree of plastic deformation inside the material as well as on the surface by means of carbide analysis. (From *Zarod. Lab.,* v. 12, 1946, p. 1.)

4-98. **Microstructure of Hard Facing Alloys.** H. W. Sharp. *Welding Journal,* v. 25, Oct. '46, p. 936-941.

Hard facing alloys and rods are divided into four groups for purpose of discussion. The properties and applications of each group and of some of the individual members are described, with particular emphasis on microstructure as shown by means of 11 photomicrographs.

4-99. **The Equilibrium Diagrams of Certain Alloys of Iron.** W. Hume-Rothery and J. W. Christian. *Philosophical Magazine,* v. 36, Dec. '45, p. 835-842.

Equilibrium diagrams of the alloys of iron with the transition elements of the same period. The diagrams of the systems Fe-Ti, Fe-V, Fe-Cr, Fe-Mn, Fe-Co, and Fe-Ni are given and the relationships of these equilibria to atomic structure are pointed out.

4-100. **The Lattice Spacing of Rubidium Between −183° C. and +19° C.** W. Hume-Rothery and Kathleen Lonsdale. *Philosophical Magazine,* v. 36, Dec. '45, p. 842-845.

A more accurate determination of the lattice spacing, together with data for the mean coefficients of linear expansion over certain ranges of temperature.

4-101. **The Elastic Constants of Anisotropic Materials.** R. F. S. Hearmon. *Reviews of Modern Physics,* v. 18, July '46, p. 409-440.

Reviews the theoretical and experimental points of interest connected with the elastic constants of anisotropic materials (mainly crystals). Attention is confined exclusively to the "elastic" range, and such topics as ultimate strength and plastic slip and glide are automatically excluded. Aim has been to make the account complete to the end of 1944. Includes material on both metallic and nonmetallic materials. 125 ref.

4-102. **Some Special Metallographic Techniques for Magnesium Alloys.** P. F. George. *American Society for Metals Preprint,* no. 4, 1946, 23 p.

Some new metallographic techniques for magnesium and its alloys are given. These include methods for analyzing solid solutions within a single grain; for showing diffusion in magnesium alloys; for distinguishing microshrinkage from fusion voids in solution heat treated metal; for distinguishing the $Mg_{17}Al_{12}$ compound from the $Mg_3Al_2Zn_3$

compound; for distinguishing Dowmetal C alloy from Dowmetal H alloy in the as-cast or heat treated condition; for determining the orientation of individual grains; for showing the results of cold working to a remarkable extent; for revealing hard-to-etch grain boundaries such as exist in as-cast metal; for producing good contrast between types of precipitates; and for determining the temperature of aging.

4-103. **Stability of Austenite in Stainless Steels.** C. B. Post and W. S. Eberly. *American Society for Metals Preprint,* no. 5, 1946, 21 p.

Stability of austenite at room temperature in stainless steels investigated by measuring the change in magnetic permeability of these austenites after cold reduction. Through the range of analyses investigated, chromium-nickel stainless steels are austenitic and nonmagnetic when annealed by air treating from a temperature of 1000° C. or over. At constant cold reduction the tensile strength of substantially stable austenitic stainless steels was found to be a function of the carbon content. An empirical formula was developed to estimate the nickel content required to make a chromium-nickel steel substantially stable.

4-104. **Constitution of the System Indium-Tin.** F. N. Rhines, W. M. Urquhart, and H. R. Hoge. *American Society for Metals Preprint,* no. 8, 1946, 20 p.

Alloy system indium-tin restudied by means of precision thermal methods and, for the first time, by metallographic means. Earlier investigations have been confirmed in most respects. Describes experimental methods and results.

4-105. **A Periodic Chart for Metallurgists.** Carl A. Zapffe. *American Society for Metals Preprint,* no. 12, 1946, 28 p.

Of somewhat novel design, the chart includes the common relationships of the Mendelejeff table and other characteristics. On the basis of this chart a series of metallurgical alloy systems is presented to show the characteristic patterns that result, to aid in understanding certain principles governing metallurgical phenomena, and possibly to serve as a useful means for predicting the characteristics of new alloy systems.

4-106. **A Metallographic Etchant to Reveal Temper Brittleness in Steel.** J. B. Cohen, A. Hurlich and M. Jacobson. *American Society for Metals Preprint,* no. 17, 1946, 30 p.

Metallographic etchants and procedures which are capable of differentiating between the tough and temper-brittle conditions of steels susceptible to temper embrittlement. Steels which have been embrittled either by slowly cooling from elevated tempering temperatures or during tempering at intermediate tempering temperatures show a pronounced grain boundary attack when etched in specially developed reagents. In the tough condition same steels exhibit no grain boundary attack. Steels not susceptible to temper brittleness suffer no grain boundary attack regardless of tempering cycle. Etchant can be used to determine prior austenitic grain size of alloy steels which can be temper embrittled.

4-107. **Changes in Austenitic Chromium-Nickel Steels During Exposures at 1100 to 1700° F.** Peter Payson and Charles H. Savage. *American Society for Metals Preprint,* no. 18, 1946, 37 p.

Study of steels of the 302, 311, 309, and 310 types, with variable silicon, and with additions of nitrogen, columbium, titanium, and zirconium, shows that the formation of sigma from austenite is promoted by the presence in the steel of high percentages of chromium, silicon, and nitrogen, as well as by the additions of columbium, titanium, and zirconium. Generally long holding periods are required for the formation of sigma. Room temperature tensile and notch impact data are given for these steels after long exposures at 1400 and 1600° F. and a few results of high-temperature tests. Metallographic scheme for identifying sigma in these steels is given.

4-108. **Experimental Studies of Continuous Cooling Transformations.** C. A. Liedholm. *American Society for Metals Preprint,* no. 21, 1946, 30 p.

Methods, results, and applications of direct experimental studies of continuous cooling transformations including some data on their effect on subsequent isothermal reactions in hypo-eutectoid steel of high pearlite and bainite hardenabilities. Experimental results are presented on mechanical and physical properties of partly transformed or slack-quenched and drawn structures in such materials. Shows that the time required by the S-curve to complete an isothermal reaction in the bainite region is lengthened, in some instances more than 2000%, by ferrite rejection during continuous cooling preceding the isothermal transformation.

4-109. **Isothermal Transformation of Austenite.** Axel Hultgren. *American Society for Metals Preprint,* no. 22, 1946, 75 p.

A number of alloy steels have been subjected to isothermal transformation studies with a view to elucidating the mechanisms of the various transformations occurring at different temperatures, and the compositions and constitutions of the transformation products. Most tests were made on manganese and tungsten steels. The data have been brought together in the form of TTT-diagrams.

4-110. **Transformations in Krupp-Type Carburizing Steels.** A. R. Troiano and J. E. DeMoss. *American Society for Metals Preprint,* no. 24, 1946, 12 p.

Transformation characteristics of a low-carbon and high-carbon Krupp-type carburizing steel have been investigated. Low-carbon steel is representative of the core and the high-carbon steel representative of the carburized case. Austenizing temperatures approximating those of commercial practice were employed. An X-ray diffraction method for obtaining A_{cm} in the high-carbon steel and also for determining the carbon content of the austenite in the presence of undissolved carbides is outlined. Possibilities and limitations of the X-ray method are considered. General transformation features are discussed and evaluated in terms of the behavior of other alloy steels when possible.

4-111. The Effects of Microstructure on the Mechanical Properties of Steel. J. H. Hollomon, L. D. Jaffe, D. E. McCarthy, and M. R. Norton. *American Society for Metals Preprint,* no. 25, 1946, 39 p.

Specimens of N.E. 8735 steel were first heat treated to produce various as-quenched structures, namely, martensite, martensite plus ferrite and pearlite, and martensite plus bainite. Specimens were then tempered before testing. Specimens of S.A.E. 3135 steel were embrittled various amounts by heating at 450° C. for different periods of time after tempering at a higher temperature. Specimens of each steel with each heat treatment were tested in tensile, notched-bar impact, and fatigue tests.

4-112. Factors Influencing the Pearlitic Microstructure of Annealed Hypo-Eutectoid Steel. R. A. Grange. *American Society for Metals Preprint,* no. 26, 1946, 20 p.

Pearlitic microstructure developed by comparable isothermal annealing of each of 12 types of aluminum-killed hypo-eutectoid steel was investigated. Results indicate that character of pearlite in an annealed steel is somehow controlled by the interrelated factors: composition, thoroughness of deoxidation, and austenite grain size just prior to transformation.

4-113. Oxide Films Formed on Alloys at Moderate Temperatures. Earl A. Gulbransen, R. T. Phelps, and J. W. Hickman. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Oct. '46, p. 640-652.

Supplementing previous papers, electron microscope and electron diffraction data are presented concerning the structure of electrochemically and chemically stripped films from a series of 16 alloys consisting principally of iron, cobalt, nickel, and chromium. Both reflection and transmission methods of electron diffraction were used. 17 ref.

4-114. On the Solid Solutions of Chromium and Manganese in Aluminum. G. V. Raynor. *Philosophical Magazine,* v. 36, Nov. '46, p. 772-777.

The empirical data in connection with the above solutions are discussed and correlated with atomic and molecular structural theory. 14 ref.

4-115. An Electron Diffraction Study of Oxide Films Formed on Iron, Cobalt, Nickel, Chromium and Copper at High Temperatures. E. A. Gulbransen and J. W. Hickman. *Metals Technology,* v. 13, Oct. '46, T. P. 2068, 26 p.

Apparatus, preparation of specimens, experimental procedures and interpretation of the electron diffraction data. Effects of various factors on the oxidation processes are studied with respect to surface preparation, temperature, time, and other factors. Lattice structure transformations are shown by the studies. 23 ref.

4-116. Zinc Diffusion in Alpha Brass. A. D. Smigelskas and E. O. Kirkendall. *Metals Technology,* v. 13, Oct. '46, T. P. 2071, 5 p.

Results of additional experiments to prove that zinc diffuses more rapidly than copper in alpha brass.

4-117. The Alpha Solid Solution Area of the Copper-Manganese-Aluminum System. R. S. Dean, J. R. Long, T. R.

Graham, A. H Roberson, and C. E. Armantrout. *Metals Technology,* v. 13, Oct. '46, T. P. 2099, 19 p.

The alpha solid solution area of this system has been definitely placed for temperatures ranging from 400 to 850° C. with up to 50% Mn. 11 ref.

4-118. **Precipitation in Age-Hardened Aluminum Alloys.** A. H. Geisler and F. Keller. *Metals Technology,* v. 13, Oct. '46, T. P. 2108, 20 p.

Microstructures of numerous aged aluminum alloys were studied with the electron microscope by examining very thin oxide film specimens formed on the prepared metallographic samples by anodic oxidation and stripped by the mercury method. Photomicrographs show the excellent results obtainable by this method. Relationship of age hardening temperature and alloy composition on precipitate particle size was obtained.

4-119. **Crystallography of the Chemical Elements—I, II, & III.** *Metal Progress,* v. 50, Nov. '46, p. 847-849.

Tabulation of atomic number and element; electron arrangement in free atoms; crystal structure; lattice constants; axial ratio; coordination number; interatomic distances; atomic diameter. (Revised data sheets.)

4-120. **Iron-Carbon Equilibrium Diagram.** *Metal Progress,* v. 50, Nov. '46, p. 970.

Principal points and lines adjusted from positions in former edition of *Metal Progress* data sheet, to agree with diagram prepared for the subcommittee on phase diagrams for inclusion in the 1947 Metals Handbook.

4-121. **Some Thermodynamic Constants for the Solution Processes of Atoms in Metallic Solvents.** Sheng-Nien Wang. *Journal of Chemical Physics,* v. 14, Nov. '46, p. 643-647.

By combining the gas-metal equilibrium data available in literature and the thermodynamic quantities of gaseous molecules and atoms from the method of statistical mechanics, thermodynamic constants for the solution processes of some atoms in some metallic solvents have been obtained. The method used is illustrated by the solution of carbon atoms in iron.

4-122. **Recherche Des Causes Ayant Determiné Une Solidification a Très Gros Grains Dans un Alliage Leger. (Determination of Factors Inducing Very Coarse Grain Formation During Solidification of a Light Alloy.)** *Fonderie,* no. 8, Aug-Sept. '46, p. 305-306.

Excessive coarse crystal formation in a 2A-55U alloy (containing 19% Cu, 9.79% Si, 1.13% Mg, 0.18% Mn, 0.62% Zn, 2.40% Fe, balance aluminum) has been investigated to determine the causes. They probably are excessively high magnesium and iron content, too low copper content, and possible overheating of melt above 800° C.

4-123. **Optische Verschinjnselen Bij Sterk Geetste Metaalfolien. (Optical Phenomena in Strongly Etched Metal Foils.)** W. G. Burgers and J. Weijdema. *Metalen,* v. 1, Sept. 15, '46, p. 6-7.

Foils of rolled and recrystallized iron-nickel alloy, when etched with strong acid, show remarkable diffraction phenomena. Such phenomena are explained by the fact

that peculiarly shaped holes of microscopic size are present in the etched foils. Their form depends on the crystal structure of the material.

4-124. **Etude Des Glissements Plastiques Dans Les Cristaux d'Aluminium. (Study of Plastic Slip of Aluminum Crystals.)** M. Charles Crussard. *Revue de Métallurgie,* v. 42, Sept. '45, p. 321-333.

Plastic slip of aluminum crystals has been investigated using various methods. Laws proposed are tentative, and further investigation seems to be necessary for their establishment. However, such laws permit application of purely mathematical methods for further research. The classical method in which metals are considered as continuous and homogeneous is avoided. An attempt is made to limit the investigation to make it a practical study.

4-125. **Hypo-Eutectoid Fe-C-Mo Alloys.** Fred E. Bowman. *Iron and Steel,* v. 19, Nov. '46, p. 608-612.

Results of an investigation of the partition of molybdenum in hypo-eutectoid iron-carbon-molybdenum alloys and its relation to hardenability. 10 ref. (Presented to American Society for Metals.)

4-126. **Notes on the Properties of Some Ternary Magnesium Alloys Based on the Binary Alloy Containing 5% Tin.** J. B. Wilson. *Magnesium Review and Abstracts,* v. 6, July '46, p. 76-88.

Microstructure and properties of a series of the above alloys containing small percentages of calcium, barium, cerium, silver, cadmium, silicon, lead, antimony, bismuth, or thorium.

4-127. **A New Aluminum-Rich Phase in the Alloys of Aluminum and Manganese.** K. Little, G. V. Raynor, and W. Hume-Rothery. *Journal of the Institute of Metals,* v. 73, Oct. '46, p. 83-90.

Chill castings containing a few per cent of manganese were prepared from high-purity metals, and were annealed at different temperatures. When annealed at or above 600° C., the phases obtained agreed with the usually accepted equilibrium diagram. Castings annealed at lower temperatures showed three phase structures. X-ray diffraction photographs showed the new phase to have the same structure as the "G" ternary phase in the system aluminum-chromium-manganese. This phase was unstable at high temperatures.

4-128. **Is the Existence of Fine Structure Anisotropy in X-Ray Absorption Spectra of Monocrystals Possible?** A. I. Kostarev. *Journal of Experimental and Theoretical Physics* (U.S.S.R.), v. 16, no. 8, '46, p. 739-743. (In Russian.)

Shows that the fine structure theory of X-ray absorption by solid bodies, based on Kronig's conceptions, leads to an assumption of anisotropy in the case of monocrystals, a fact contradicting experimental data. Theory advanced by the author denies the possibility of anisotropy and is in agreement with experimental data.

4-129. **The System of Microstresses in Cold Worked Metal.** Nelson M. Blachman. *Physical Review,* v. 70, Nov. 1 and 15, '46, p. 698-704.

X-ray line widths for alpha brass, which is elastically anisotropic, depend upon crystallographic direction in a systematic manner, while for tungsten, which is elastically isotropic, they do not. Variation in line width with crystallographic directions is computed for several theoretical models of internal-stress systems. The one which fits the above results best, though poorly, is that which assumes that the homogeneously strained domains suffer uniform normal stress at random magnitude.

4-130. **Hydrogen in Steel.** J. H. Andrew, H. Lee, A. K. Mallik, and A. G. Quarrell. *Iron and Steel,* v. 19, Nov. 21, '46, p. 665-681; discussion, p. 766-789.

Work undertaken to determine the temperature at which hydrogen can most readily be removed, and in what way this temperature depends upon the composition of the steel. Formation of hairline cracks. All experiments carried out on normal commercial steels.

4-131. **Nonmetallics.** J. R. Rait and H. W. Pinder. *Iron and Steel,* v. 19, Nov. 21, '46, p. 682-695; discussion, p. 765-766.

Main sources of inclusions in steel are through deoxidation, presence of sulphur and phosphorus, and such extraneous sources as trapping of slag, trapping of corroded and eroded refractories, trapping of products of reaction between steel and refractories. Various oxides which form chief inclusions discussed. Different inclusions resulting from uphill pouring and top pouring. Practical applications to steelmaking.

4-132. **Martensite. Its Structure in the Tempered Condition.** W. J. Wrazej. *Iron and Steel,* v. 19, Nov. 21, '46, p. 717-719.

Martensite tempered at a low temperature (100° C.) changes over into ferrite mixed with precipitated cementite in primary form.

4-133. **Twin Relationships in Annealed Copper Strip.** P. Coheur and C. S. Barrett. *Metals Technology,* v. 13, Dec. '46, T.P. 2104, 7 p.

Twinning of copper strip containing 0.19% iron. First-order twin relationship was found in recrystallization texture of sample cold rolled 99% and annealed from 450 to 700° C. Annealing for longer times or at higher temperatures causes an increase in twinned material. Laue photographs indicate that recrystallization is complete before these changes take place; hence they are associated with grain growth. 12 ref.

4-134. **Hot Deformation Structures, Veining and Red Shortness Cracks in Iron and Steel.** Axel Hultgren and B. Herrlander. *Metals Technology,* v. 13, Dec. '46, T.P. 2106, 17 p.

Specimens of low and medium-carbon, red short steel were deformed at temperatures somewhat below and above Ac_3 and the structures obtained studied microscopically. 17 ref.

4-135. **Transformation of Austenite in an Aluminum-Chromium-Molybdenum Steel.** R. A. Grange, W. S. Holt, and E. T. Tkac. *Metals Techology,* v. 13, Dec. '46, T. P. 2109, 13 p.

Isothermal transformation behavior of a sample from a commercial heat of nitralloy, an aluminum-chromium-molybdenum steel containing 1.25% Al, together with supplementary data including equilibrium transformation temperatures, temperature range of martensite formation, and end-quench hardenability. 13 ref.

4-136. **Twinning in Polycrystalline Magnesium,** C. S. Barrett and C. T. Haller, Jr. *Metals Technology,* v. 13, Dec. '46, T.P. 2103, 10 p.

An investigation of the twinning produced in polycrystalline sheet by plastic deformation as a function of direction, amount, speed, and temperature of deformation. Other variables considered were composition and temper of sheet, sheet in which twins were previously produced, and cases where twins were previously produced and the sheet was then annealed. Samples free from preferred orientations were produced on a laboratory scale by proper control of variables.

SECTION V

POWDER METALLURGY

5-1. **Aluminum Powder Production.** G. W. Birdsall. *Steel,* v. 118, Jan. 14, '46, pp. 82-85, 98, 100, 103.

Novel methods at Reynolds Metals, using three different processes. Aluminum powders find increasingly important applications in coatings, chemical processes, pyrotechnics, powder metallurgy, silicosis treatment, aerated concrete.

5-2. **Some Observations on the Extent to Which the Properties of Sintered Compacts Are Affected by the Mode of Production of Iron Powder.** W. Dawihl and U. Schmidt. *Engineers' Digest (American Edition),* v. 2, Dec. '45, p. 607-609.

Extent to which the process of pressing and sintering can influence the properties of the various types of iron powder. (Abstract from *Stahl und Eisen,* v. 65, no. 1-2, Jan. 4, '45.)

5-3. **Powder Metallurgy.** T. C. Du Mond. *Materials and Methods,* v. 23, Jan. '46, p. 123-124.

Practical sizes defined; greater accuracies held; hot pressing increases physicals.

5-4. **Making Electrical Contacts With Metal Powders.** E. I. Larsen. *Steel,* v. 118, Jan. 28, '46, p. 119, 161-162, 165.

Discussion of factors bearing on adoption of powder metallurgy for fabrication of special property contacts—including selection of type, density, physical properties, thermal conductivity, resistance to erosion and corrosion, and joining medium to be used.

5-5. **General Rules for Powder Metallurgy.** Henry H. Hausner. *American Machinist,* v. 90, Feb. 14, '46, p. 104-105.

Effects of processing on the physical properties of compacts of metal powders are reduced to thirteen trend charts.

5-6. **Engineering Properties of Sintered Versus Cast Metals.** Paul Schwarzkopf. *Product Engineering,* v. 17, Feb. '46, p. 122-126.

Selection and evaluation of powder metallurgy against conventional production methods will be facilitated by the tables given. Data compare principal mechanical characteristics for a number of metals and of steels made either by the sintering of powders or by the working of cast metals.

5-7. **Self-Lubricating Bearings Made by Powder Metallurgy.** M. T. Victor. *Electrical Manufacturing,* v. 37, Feb. '46, p. 123-125, 210, 212, 214, 216.

By adjusting size of pores in the metal to correspond with the viscosity of the lubricating oil, an automatic supply of it on the bearing surfaces may be assured.

5-8. **German Iron and Nickel Powders.** T. P. Colclough. *Iron Age,* v. 157, Feb. 21, '46, p. 48-49.

At the Oppau Works of I. G. Farben high grade nickel and iron powders were made by the carbonyl process. Report on the manufacturing procedures used.

5-9. **Symposium on Production and Design Limitations and Possibilities for Powder Metallurgy Parts.** *Metallurgia,* v. 33, Jan. '46, p. 154-156.

Deals more particularly with design factors in powder metallurgy.

5-10. **Carbursintering of Iron Powders.** A. S. Margolies. *Iron Age,* v. 157, Feb. 28, '46, p. 60-63.

Iron powder was compacted at various pressures and then carbursintered, i. e., carburized and sintered simultaneously, for various times at 1700° F. Microstructures and physical properties of the products obtained are reported with recommendations for use of this process for commercial applications. 8 ref.

5-11. **Powder Metallurgy of Iron.** G. H. S. Price. *Metal Treatment,* v. 12, Winter, '46, p. 275-286, 274.

Nature of powder—particle size and shape. Effect of pressure in relation to density, cohesion of compacts and the relation of conductivity to pressure. Mechanical and physical properties of sintered iron including cold pressing followed by sintering, hot coining of sintered specimens and hot pressing the powder. 71 ref.

5-12. **Preparation and Properties of Ductile Titanium.** R. S. Dean, J. R. Long, F. S. Wartman, and E. L. Anderson. *Metals Technology,* v. 13, Feb. '46, T.P. 1961, 13 p.

Laboratory investigation of the preparation of ductile titanium by reduction of $TiCl_4$ with magnesium has progressed satisfactorily up to the production of 15-lb. batches of titanium powder without encountering any technical difficulties that would prevent the expansion and use of this process on a large scale. The powder has been consolidated by pressing into compacts at a pressure of 50 tons per sq. in. and sintering at 1000° C. in a vacuum. The metal has excellent corrosion resistance. 6 ref.

5-13. **Ductile Titanium—Its Fabrication and Physical Properties.** R. S. Dean, J. R. Long, F. S. Wartman, and E. T. Hayes. *Metals Technology,* v. 13, Feb. '46, T.P. 1965, 17 p.

Investigation of fabrication methods for powders and the properties produced by them. Hardness, density, microstructure, and tensile properties were determined at various stages in the working and annealing; and resistivity measurements were made on a few bars and drawn wire.

5-14. **Silicide-Hardened Copper Compacts for Bearings.** F. R. Hensel, E. I. Larsen and E. F. Swazy. *Metals Technology,* v. 13, Feb. '46, T.P. 1976, 8 p.

New material produced by powder metallurgical methods susceptible to precipitation-hardening. Produced an extremely hard bearing that could be run at high speeds and loads; shaft did not show excessive wear.

5-15. **Manufacture of Ferrous Metal Powder Parts.** *Metal Progress,* v. 49, March '46, p. 539-547.

Pictorial description of procedure followed at American Electro Metal Corp. for manufacture of precision parts of complicated shape.

5-16. **Compressed Air Speeds Powder Metal Forming.** *Materials and Methods,* v. 23, March '46, p. 729.

Applications of air include cleaning, forming and bonding to backing plates.

5-17. **Powder Metallurgy—an Industry Founded Upon the Modern Press.** Joseph G. Cowley. *Modern Industrial Press,* v. 8, March '46, p. 26, 28.

Double-action press is built for the rapid production of metal parts up to 1½ in. diameter, having a maximum depth of fill of 1⅛ in.; capable of turning out 600 parts each minute of operation.

5-18. **Powdered Iron Cores.** C. T. Martowicz. *Steel,* v. 118, April 1, '46, p. 146-148, 166.

Characteristics of electrical-grade iron powders make them especially suited for use in high-frequency magnetic applications and for other electronic purposes. 10 ref.

5-19. **Casehardening of Sintered Steel.** George Stern and Jesse Greenberg. *Powder Metallurgy Bulletin,* v. 1, March '46, p. 18-23.

Present-day powder metallurgy has made possible the production of relatively high-strength parts that are capable of competing with machined parts made from low and medium-carbon steels and low-alloy steels. To duplicate the surface hardness frequently called for in the specifications for such parts, it is necessary to carburize and subsequently quench and draw powder metal steel parts of low carbon content.

5-20. **Sintered Metallic Powders for Electrical Contacts.** *Engineering,* v. 161, Feb. 22, '46, p. 188-190.

The exacting requirements which circuit-breakers are expected to meet are likely to be facilitated by the development of sintered metallic powders for the manufacture of the switch contacts.

5-21. **Engineering Properties of Sintered Metals.** Paul Schwarzkopf. *Product Engineering,* v. 17, April '46, p. 268-272.

Information relating to the three classes of sintered powder metal pressings and 11 tables covering physical properties.

5-22. **Call on Powdered Metal Process for Millions of Nickel Filters.** *Steel,* v. 118, April 22, '46, p. 84-85, 132.

Airflow and porosity tests on new machine insure uniformity in cup-shaped powdered metal filter for switch of V-T fuse. Superfinished dies afford dimensional control.

5-23. **Cemented Steels—a New High-Strength Powder Metallurgy Product.** Fred P. Peters. *Materials & Methods,* v. 23, April '46, p. 987-991.

Sinteel "G" is produced by infiltrating a porous steel skeleton (pressed from metal powders) with molten copper alloy. Low pressing pressures are used; the infiltration is accomplished by penetrating the steel skeleton with the liquid copper, and no subsequent coining operation is required. The final product is virtually pore-free, has tensile strengths of 50,000 to 100,000 psi., is heat treatable and has the precipitation hardening properties of iron-copper combinations. It is exceptionally amenable to brazing and is readily machinable.

5-24. **Heat Treating Carburized Sintered Steel.** George Stern and Jesse Greenberg. *Iron Age,* v. 157, April 25, '46, p. 56-61.

An investigation to determine the effects of various carburizing methods and subsequent heat treatment on the depth, hardness, and microstructure of the case obtained on three different types of sintered steel and cold rolled steel. Results obtained with the powder metal specimens are very similar to cold rolled S.A.E. 1015 steel.

5-25. **Cemented Steels.** E. S. Kopecki. *Iron Age,* v. 157, May 2, '46, p. 50-54.

Complicated shapes possessing high strength and density can now be produced, utilizing low pressures, by an infiltration method of a molten low-melting metal into a steel powder compact of a higher melting temperature.

5-26. **TiH Increases Compact Density.** Harry L. Strauss, Jr. *Steel,* v. 118, May 6, 1946, p. 138, 160.

Titanium hydride also improves other physical properties of metal powders by reducing oxides during sintering. Need for externally generated reducing atmosphere eliminated.

5-27. **Carbon-Graphite Mechanical Parts.** Fremont F. Ruhl. *Steel,* v. 118, May 20, '46, p. 108-110, 165-167.

Rings, seals, bearings, disks, blades and other parts, press-molded and baked at 3000° F., stand up under extremes of speed, temperature and pressure, yet possess virtues of strength, hardness, self-lubrication and light weight.

5-28. **Preparation of Beryllium Powder.** Jack M. Tien. *Electrochemical Society Preprint* 89-19, April 15, '46, p. 223-231.

Experiments on the preparation of beryllium metal powder have been carried out by the electrodeposition of beryllium from nonaqueous solvents, by the electrolysis of fused salts at a temperature below 245° C., and by the reduction of anhydrous beryllium chloride under reduced pressure by metallic sodium in the vapor state. This last process was found to be the best. 63 ref.

5-29. **A 90% Tungsten Alloy and Its Uses.** *Machinery (London),* v. 68, May 2, '46, p. 566-567.

"Heavy alloy" has a 90% tungsten base with additions of nickel and copper. Three metal powders, intimately mixed in the required proportions, are compacted under a pressure of 10,000 psi. and are then sintered at 1450° C. (compared with a sintering temperature of nearly 3000°

C. for pure tungsten). After sintering the alloy has a density of approximately 17 g. per cc.—about half as much again as lead—and is readily machinable.

5-30. **Cemented Steels—Infiltration Studies With Pure Iron and Copper Powders.** C. G. Goetzel. *Powder Metallurgy Bulletin,* v. 1, May '46, p. 37-43.

The recently developed cemented iron and steel products (Sinteel-G)—manufactured by infiltration of a porous iron or steel skeleton with a molten copper alloy—represent virtually nonporous, high-strength materials that are easily machinable, platable and self-brazing.

5-31. **Effect of Coining on Precipitation Hardening of Sinteel-P.** Wilson N. Pratt. *Powder Metallurgy Bulletin,* v. 1, May '46, p. 43-44.

Stress left in the bars after coining increases the final hardness after precipitation treatment. As the tensile strength of Sinteel-P (copper-nickel-tin powder mixture) is proportional to its final hardness, the bars might be expected to be stronger in the coined and precipitated condition. The coining of sintered parts thus can be expected to have a beneficial effect on tensile strength, yield point and final hardness of age hardening alloys.

5-32. **Permet, a Nonferrous Permanent Magnet Made From Powders.** Robert Steinitz. *Powder Metallurgy Bulletin,* v. 1, May '46, p. 45-47.

A material containing about 30% cobalt, 45% copper, and 25% nickel is best suited for many applications. It is now being manufactured by the American Electro Metal Corp.

5-33. **Extruding Powdered Metals to Form Synthetic Welding Wire.** F. G. Daveler. *Materials & Metals,* v. 23, May '46, p. 1317-1320.

Drawn-wire base is clad with alloying elements in much the same manner as rods are flux-coated to produce special application welding rods.

5-34. **Designing Powder Metal Parts.** *Steel,* v. 118, June 3, '46, p. 108-110, 156-159.

Essential for designer to understand in detail problems and methods of compacting, or briquetting, powders. Briquetting is the "key operation" in powder metallurgy, determining what shapes are feasible and to what extent optimum physical characteristics can be obtained.

5-35. **British Powder Metallurgy—Its History, Development, and Commercial Future.** W. D. Jones. *Metal Industry,* v. 68, May 31, '46, p. 431-435.

Bessemer's venture; position before the war; war production; manufacture of articles; forming piston rings; brass and bronze products; a wartime application; theoretical aspects; Bowden's work; mechanism of sintering; the commercial future; no phase rule limits.

5-36. **Design of Powder Metallurgy Parts.** M. T. Victor and C. A. Sorg. *Western Machinery and Steel World,* v. 37, May '46, p. 248-251.

Factors to be considered before process is adopted. Powder metallurgy compared with other competitive processes.

5-37. **Powder Metallurgy and the Refractory Metals.** Allan L. Percy. *Steel,* v. 118, June 17, '46, p. 106-108, 146, 148, 150, 152, 154.

Process ideally adapted for manufacture of tungsten, tantalum, molybdenum and columbium in commercial quantities where high melting points make casting of bars or ingots impractical. Physical plant impressive.

5-38. **Nickel Production.** *Metal Industry,* v. 68, May 24, '46, p. 416.

The carbonyl process for production of nickel powder, the principles of which were first worked out by Mond, was used by I. G. Farbenindustrie at their Oppau works at Ludwigshafen. (Extract from a report by T. P. Colclough of the Ministry of Supply, for the Combined Intelligence Objectives Sub-Committee.)

5-39. **What Cemented Carbides Offer the Designer.** Richard K. Lotz. *Machine Design,* v. 18, June '46, p. 135-137, 184.

Carbides are available in a variety of grades, can be formed to specified shapes to close tolerances, approach the diamond in hardness (a property which is retained at extremely high temperatures), have high compressive strength, and offer good general corrosion resistance.

5-40. **Quality Control and Research on Cemented Carbides.** *Machinery (London),* v. 68, June 27, '46, p. 809-816.

Manufacture of Wimet; Haseley Manor Laboratories; spectrographic and X-ray crystallography laboratory; determination of particle size; X-ray diffraction analysis.

5-41. **The Use of Ultrafine Particles in Powder Metallurgy.** Henry H. Hausner. *Materials & Methods,* v. 24, July '46, p. 98-102.

Precise specification of metal powder size leads to uniformity of results in density, break strength, hardness and porosity of powder metal compacts. Ultrafine copper powders were tested and found to permit the manufacture of larger parts because the pressure applied to the unit of the surface can be kept low. The great mixability of this 2-micron copper powder with other fine powders, such as graphite, permits the manufacture of compacts possessing excellent structural uniformity.

5-42. **Production of Electrolytic Iron Powder.** Harold V. Trask. *Metal Progress,* v. 50, Aug. '46, p. 279-282.

Iron is deposited as a smooth electrolytic plate upon cathodes of stainless steel and the iron is detached by slight raps of a hammer or flexing of the sheet. Ball-mill grinding is the second major stage. Annealing of the ground product is done to soften the embrittled iron and to reduce to metal any iron oxide which may be present. The pilot plant described has the capacity to produce 400 lb. of powder per day in five grades. A commercial plant is under construction.

5-43. **Methods Used for Overcoming Certain Limitations in the Pressing of Metal Powders.** R. P. Seelig. *Powder Metallurgy Bulletin,* v. 1, July '46, p. 54-63.

The most frequently discussed limitations in powder metallurgy are based on the pressing or molding opera-

tion. Outlines certain methods which have been developed in overcoming some of the restrictions on shapes and dimensions which can be handled by molding metal powders. Many limitations are primarily economical in nature.

5-44. **Cemented Carbides Used for Other Purposes Than Cutting Tools.** K. R. Beardslee. *Machinery,* v. 52, Aug. '46, p. 150-156.

Use of carbides for wire and rod dies; for deep drawing dies; for punches and dies; in the forge shop and foundry; in machine tool construction; in the textile industry; application to office equipment; in manufacturing coated welding rod; in the food and refrigeration fields; applications in the oil and paint and telegraph fields; on hand tools.

5-45. **Hard Carbides Find Noncutting Uses.** Philip M. McKenna. *American Machinist,* v. 90, Aug. 15, '46, p. 117-120.

Table gives physical properties of carbides and steels. A number of current applications are discussed and illustrated to serve as examples where savings can be made in shopwork.

5-46. **Properties of Sintered Iron-Copper Powders.** F. C. Kelley. *Iron Age,* v. 158, Aug. 15, '46, p. 57-60.

Effects of variation in sintering temperature, sintering time and copper content, on the physical properties of sintered copper-iron powders. Results obtained from various heat treatments conducted on sintered specimens, and comparison between properties of as-received and annealed powders.

5-47. **The Composite Carbides in Steel Cutting Cemented Carbides.** A. G. Metcalfe. *Metal Treatment,* v. 13, Summer '46, p. 127-133.

Role of titanium carbide in helping to form a tenacious oxide coating on a tool tip which enhances tool life. Structures of the titanium and tungsten carbides investigated. Compounds are formed in the TiC-WC system, which is a simple solid solution. 9 ref.

5-48. **Sinteel "G".** *Metal Treatment,* v. 13, Summer '46, p. 141, 140.

Application of infiltration technique for high-strength products made of steel or iron cemented with copper alloy. (From *Materials and Methods.*)

5-49. **Alloys of the Heavy Metals.** G. Fitzgerald-Lee. *Aircraft Engineering,* v. 18, July '46, p. 239-241.

An outline of recent developments in production of alloys of tungsten and tantalum, principally by powder metallurgy. Present and potential applications are discussed.

5-50. **Powdered Metal Vs. Other High Production Methods.** Herbert Chase. *Materials & Methods,* v. 24, Aug. '46, p. 363-369.

Some of the factors that demand consideration in determining whether particular parts should be made from powdered metal or be produced by other means. Processes that may compete are sand casting, die casting, stamping, and screw machine production.

5-51. **The Production of Aircraft Piston Rings by Powder Metallurgy.** J. A. Judd. *Machinery (London),* v. 69, July 25, '46, p. 109-112.

Early scuffing difficulties; press design; the sintering operation.

5-52. **Nickel in Wartime Germany.** David D. Howat. *Chemical Age,* v. 55, Aug. 17, '46, p. 191-194.

Production of nickel powder at Oppau; smelting and refining at Hamburg; treatment of copper-nickel residues; manufacture of iron powder from steel scrap and pyrites; control of metal powder particle size. The nickel ore was low grade material from Petsamo, Finland. It contained about 2½% copper and 4½% nickel.

5-53. **Seminar on the Theory of Sintering.** F. N. Rhines. *Metals Technology,* v. 13, Aug. '46, T. P. 2043, 13 p.; discussion 5 p.

This review of the theory of sintering of pure metal powders summarizes published experimental results concerning the initial bond at room temperature; effects of pressure, time, gases and other foreign substances on sintering; effects of sintering upon structure and physical properties; develops "a composite theory of sintering". 62 ref.

5-54. **The Pressing Operation in the Fabrication of Articles by Powder Metallurgy.** Richard P. Seelig and John Wulff. *Metals Technology,* v. 13, Aug. '46, T. P. 2044, 13 p.

The process is divided into the phases of packing, elastic and plastic deformation, and cold working. Effect of lubricants on the density gradient of compacts; effect of raw material on commercial pressing operations; requirements for press equipment; requirements for die materials.

5-55. **A Study of the Physical Properties and Microstructure of Sintered Steel.** George Stern. *Metals Technology,* v. 13, Aug. '46, T. P. 2045, 15 p.

A method consisting of pressing and subsequently sintering an intimate mixture of iron powder and graphite in a suitable atmosphere to produce a steel, was studied, using both electrolytic and reduced iron powder. Effects of a cracked propane atmosphere in presence of lithium salts were evaluated. Properties of product compared with those of ordinary steel. 15 ref.

5-56. **Nickel-Iron Alloys Produced by Powder Metallurgy.** Laurence Delisle and Aaron Finger. *Metals Technology,* v. 13, Aug. '46, T. P. 2046, 13 p.

Preparation and physical testing of a series of alloys. Physical properties and structure are compared with those of the corresponding alloys prepared by conventional procedures.

5-57. **Molding Powder Metallurgy Parts.** Richard Paul Seelig. *Tool & Die Journal,* v. 12, Sept. '46, p. 78-83, 158.

Several press tool design considerations necessary to overcome certain production limitations imposed by metal powder behavior characteristics.

5-58. **Heavy Alloy Aids Machine Design.** G. H. S. Price. *Iron Age,* v. 158, Sept. 19, '46, p. 62-63.

Recently developed in England is a new material which, while said to be equally as strong as steel, has twice the density. High-tungsten powder metallurgy product is specifically intended for use in cases where moving parts must be balanced, yet space conserved. Physical properties of the material and applications are described.

5-59. **Wire Drawing Dies.** *Wire Industry,* v. 13, Sept. '46, p. 505-506.

Some of the intricate operations in the fabrication of suitable tungsten carbide dies.

5-60. **Platinum-Iridium Alloys.** O. E. Zvyangintsev, A. G. Rakhahtadt, and M. A. Vladimirova. *Metallurgia,* v. 34, Aug. '46, p. 195-198.

Process of diffusion in platinum-iridium alloys has been studied with alloys containing 10, 25, 35, and 50% iridium, prepared in the form of powder. Formation of solid solutions at comparatively low temperatures and in relatively short periods of time is of practical importance from the point of view of employing the method of powder metallurgy for the technical preparation of platinum-iridium alloys. (Translated from *Journal of Applied Chemistry, U.S.S.R.,* v. 17, '44, p. 22-30.)

5-61. **Densities of Iron Powder Compacts.** Robert Steinitz. *Powder Metallurgy Bulletin,* v. 1, Sept. '46, p. 70-71.

A large range of densities can easily be produced by using different iron powders and pressures. For convenient selection a table was prepared listing powders and pressures for small intervals in final density. Same values are plotted as curves and specifications of the used powders are tabulated.

5-62. **Thermal Expansion Test for Tungsten.** D. E. Tesen. *Powder Metallurgy Bulletin,* v. 1, Sept. '46, p. 75.

Expansion characteristics of unpressed tungsten powder during sintering at low temperature are believed to be related to the lamp performance of wire prepared from the powder.

5-63. **Powder Metallurgy.** J. E. Newson. *Institution of Mechanical Engineers Proceedings,* v. 154, Sept. '46, p. 208-213.

History, advantages, limitations and terms used in powder metallurgy; manufacturing operations and applications. 24 ref.

5-64. **German Production of Sintered Boron Carbide.** *Industrial Diamond Review,* v. 6, Oct. '46, p. 413.

Pure boron carbide is the hardest known material next to diamond. It was obtained by heating a mixture of boric acid in pure petroleum coke in an arc furnace at about 2600° C., was then ground in steel ball mills to a maximum grain size of about 8 microns and the unchanged boric acid was washed out with acetone. The powder was sintered in a graphite mold under 40 kg. per sq. cm. pressure, at a temperature of 2200° C. in a graphite tube resistance furnace. (From report by M. Fleischmann, U. S. (Ord.) CIOS Target Number 21/202, Metallurgy, H. M. Stationery Office, London, 1946.)

5-65. **Powder Metallurgy.** *Wire Industry,* v. 13, Oct. '46, p. 561.

Basic principles of its application to tungsten dies and copper screening.

5-66. **New Ceramic Combines Ceramic Materials and Powdered Metals. Part I.** Henry H. Hausner. *Ceramic Industry,* v. 47, Oct. '46, p. 87-88.

By means of new process such properties as magnetism, electrical conductivity, heat conductivity and hardness can be incorporated into ceramic products. Potential applications and close relationship of powder metallurgical and ceramic processes.

5-67. **Formation and Transformation Studies of Iron-Carbon Powder Alloys.** John F. Kahles. *American Society for Metals Preprint,* no. 13, 1946, 34 p.

Results show that very pure steels may be prepared by pack carburizing compressed carbonyl-L iron powder and that the austenite transformation characteristics of these powder products do not differ markedly from steels made from the liquid state. A TTT-diagram for a "powder" steel is shown for a composition of 0.87% carbon. In addition some interesting trends are presented for the carburization of compressed powdered iron.

5-68. **Powdered Metals Hot Pressed.** *Product Engineering,* v. 17, Nov. '46, p. 93.

A press that simultaneously heats metal powder and compresses the powder in the die comprises a simple straight-line type hand press with a transformer connection to the die holder for resistance heating of the carbon dies. Top and bottom die plungers are also carbon.

5-69. **New Ceramic Combines Ceramic Materials and Powdered Metals. Part II.** Henry H. Hausner. *Ceramic Industry,* v. 47, Nov. '46, p. 90, 92, 94, 96.

Combination of sintered glass and sintered metal oxides to produce novel and useful materials. Experiments along the lines of *(a)* mixing, compacting, and heat treating to form homogeneous material and *(b)* combining the two types of materials in the forms of bonded materials. Preliminary experiments, the results of which are illustrated, indicate the feasibility of both types of processes.

5-70. **The Production and Properties of Pressed Permanent Magnets.** S. Harris. *Plastics (London),* v. 10, Oct. '46, p. 534-541.

New methods of production for pressed permanent magnets; mechanical and physical properties of plastic-bonded magnets. The original carbon steels were replaced by cobalt steels and then by iron-nickel-aluminum alloys. Each new development represented a considerable increase in the magnetic energy of the material. 14 ref. (Translated from Dehler, *"Elektrotech. Z.",* v. 62, 1941, p. 601.)

5-71. **Some Factors Affecting Particle Size of Hydrogen-Reduced Tungsten Powder.** Bernard Kopelman. *Metals Technology,* v. 13, Oct. '46, T. P. 2100, 16 p.

Based on published data and some experimental data obtained by the author, a general theory of factors affecting the particle size of tungsten metal powder obtained by reduction of the oxides in hydrogen is offered.

The control of particle size of the powder used to make wire for lamps and radio tubes is necessary to avoid sagging. 26 ref.

5-72. **Some Considerations in Designing Parts for Powder Metallurgy.** Irving J. Donahue. *Mechanical Engineering,* v. 68, Nov. '46, p. 943-948.

Limitations and advantages of process; pressing operations; design considerations; machining operations necessary for some parts; secondary operations.

5-73. **Carbides in Powder Metallurgy.** James R. Longwell. *Steel,* v. 119, Dec. 2, '46, p. 130, 132, 159-160, 162.

Physical properties can be controlled carefully in making parts from carbides of tungsten, titanium or other metals with metallic binders such as nickel or cobalt.

5-74. **Wear Resistant and Hot-Strength Metallic Materials —Powder Metallurgy as Most Promising Method for Their Development and Production.** Paul Schwarzkopf. *Powder Metallurgy Bulletin,* v. 1, Nov. '46, p. 86-91.

Use of powder metal products for wear resisting and for high temperature applications. 14 ref.

5-75. **Powder Metallurgy of Nickel.** G. H. Price. *Metal Treatment,* v. 13, Autumn '46, p. 208-212.

Comprehensive review of the literature. Effects of pressure and sintering conditions, mechanical properties, and industrial applications. 42 ref.

5-76. **Effect of Particle Size on Iron Powder Properties. Part I.** *Iron Age,* v. 158, Dec. 5, '46, p. 72-76.

Results of an extensive wartime research program in which two reduced-type and two electrolytic iron commercial powders were investigated as to the effects of particle size on properties of powders and powder compacts.

5-77. **Fernico From Metal Powders.** E. E. Burger. *General Electric Review,* v. 49, Dec. '46, p. 22-24.

Applications of alloy of iron, cobalt, and nickel. The product from conventional steel-mill technique is not too satisfactory because of variations in composition which are introduced. The sintered-powder method, which is described in some detail, is more satisfactory. Electron-tube circuit for temperature control of the furnace presented.

5-78. **Effect of Particle Size on Iron Powder Properties. Part II.** *Iron Age,* v. 158, Dec. 12, '46, p. 76-80.

Need for a method of analyzing distribution of subsieve particles. (Concluded.)

SECTION VI

CORROSION

6-1. **Corrosion of Steel Salt-Bath Pots by Molten Alkali Nitrates.** R. J. Box and B. A. Middleton. *Engineers' Digest (American Edition)*, v. 2, Nov. '45, p. 575.

Data based on observations during several years on salt-bath furnaces in a group of factories. (From Paper for Iron and Steel Institute.)

6-2. **Corrosion Protection of Steel Pipe by Resin Baking Coatings.** *National Petroleum News*, v. 37, Dec. 5, '45, pp. R992, R994.

Induction heating used to overcome problems of application of phenolic resins.

6-3. **Corrosion.** C. P. Larrabee. *Iron and Steel*, v. 18, Nov. '45, pp. 497-502.

In sea water, plain and low alloy steels are shown to have an average corrosion rate of about 22 mg. per sq. dm. per day (0.004 in. per yr. average penetration). Pitting attack characterizes the corrosion of stainless steel although the presence of 2 to 3% molybdenum in the 18-8 type or very high alloy content diminishes this tendency. (From *Transactions of the Electrochemical Society.*)

6-4. **Corrosion of Aluminum.** P. A. Haythorne. *Aircraft Production*, v. 7, Nov. '45, pp. 514-516.

Effect of low melting materials used in drop hammer dies.

6-5. **Protective Packaging.** Orrin C. Rutledge. *General Electric Review*, v. 48, Dec. '45, pp. 16-19.

Corrosion preventive compound protection; waterproof protection and moisture-vapor-proof protection briefly described.

6-6. **Valve Facing Alloy Resists Corrosion at High Temperatures.** V. C. Young. *Materials & Methods*, v. 22, Dec. '45, pp. 1744-1745.

Wear, deformation and hardness characteristics provided for operating temperatures over 1200° F.

6-7. **A Method of Assessing Wear Due to Friction and Corrosion.** Phillip M. Fisk. *Sheet Metal Industries*, v. 22, Dec. '45, pp. 2138-2141, 2146.

Corrosion in moving parts; corrosion and wear in hinges; test conditions; testing machine; experimental procedure.

6-8. **Note on Corrosion.** W. Percival and J. J. Aggio. *Chemical Age,* v. 53, Dec. 15, '45, p. 564.

Concludes that the mechanical stoker operating with raw fuel containing chlorides materially contributes to a very short life when used along with cast iron heating boilers.

6-9. **Diffusion in R301 Alloys and Its Effect on the Corrosion Resistance.** L. F. Mondolfo. *Metals Technology,* v. 12, Dec. '45, T. P. 1940, 13 pp.

Material and procedure; spectrographic analysis; microexamination; measurement of electrolytic potential; corrosion test; discussion of results. 12 ref.

6-10. **Total-Immersion Apparatus for Corrosion Tests Evaluates Either Metal or Solutions.** *Steel,* v. 118, Jan. 14, '46, p. 106.

Apparatus gives results of magnitude and reproducibility which are sufficient for most corrosion measurements. Illustrations give details.

6-11. **Corrosion of Steel Salt-Bath Pots by Molten Alkali Nitrates.** R. J. Box and B. A. Middleton. *Engineering,* v. 160, Dec. 21 and Dec. 28, '45, p. 523-524, 543.

Based on observation during several years on salt bath furnaces in a group of factories. Salt baths consisted of sodium nitrate-potassium nitrate mixtures used for heat treatment of duralumin type alloys up to temperatures of 500° C. (Paper for Iron and Steel Institute.)

6-12. **Developments in Corrosion Studies and Corrosion Control.** H. M. Olson. *Iron and Steel Engineer,* v. 23, Jan. '46, p. 80-95.

Compilation of important literature on corrosion. Comments mostly on corrosion due to water conditions.

6-13. **Formaldehyde as an Inhibitor of Corrosion Caused by Hydrogen Sulphide.** P. L. Menaul and T. H. Dunn. *Petroleum Technology,* v. 9, Jan. '46, T.P. 1970.

Results of an investigation made to develop a method of combatting corrosion of subsurface oil-well equipment caused by brines containing hydrogen sulphide. Carbon monoxide, formaldehydes, and certain cyanide compounds were found by laboratory tests to effectively inhibit corrosion of steel by sulphide brines. Experiments were made using formaldehyde as an inhibitor. It was found that the inhibitor treatment successfully prevented the severe corrosion previously experienced in these wells. 6 ref.

6-14. **A Study of Electrolytic Corrosion.** *American Railway Engineering Association Bulletin* 457, v. 47, Jan. '46, p. 316-332.

Some rather surprising results were obtained in a study of the electrolytic corrosion of steel bars encased in buried concrete specimens which has been conducted during the last two years.

6-15. **Recent Russian Work on Corrosion.** *Chemical Age,* v. 54, Jan. 5, '46, p. 5-8.

Corrosion resistance (stability) of different materials employed in construction of apparatus destined for fundamental Russian chemical industries, including: *(a)* pro-

duction of halogen salts, such as chlorides; *(b)* sulphur compounds; *(c)* fluorine compounds; *(d)* halogen compounds of the iodo-bromine type; *(e)* general research on materials liable to corrosion.

6-16. **Bimetallic Double-Wall Tubing for Combating Corrosion.** *Product Engineering,* v. 17, Feb. '46, p. 102-103.

Metals can be combined to form a two-wall tube to withstand simultaneously two different types of corrosive attack. Typical applications are described, with a summary of the behavior and characteristics of a few common metals and alloys that are used for tubing. Designs are discussed for assembling two-wall tubing in heat exchangers.

6-17. **Chemical Plant in Germany. Corrosion Problems in the Oils and Fats Industry.** *Chemical Age,* v. 54, Jan. 19, '46, p. 81-82.

Special kinds of steel which have been developed for different kinds of corrosion, such as chemical, electrochemical, and a combination of the two. Various forms of protection are grouped under three heads: *(a)* special steels, cast irons, and alloys thereof; *(b)* removal of active or attacking agent from the material treated; and *(c)* coatings.

6-18. **Acid Corrosion of Magnesium.** G. E. Coates. *Industrial Chemist,* v. 22, Jan. '46, p. 11-15.

Purpose of the experimental work described was to measure the hydrogen overvoltage of magnesium with the object of interpreting the electrode potential of the corroding metal; to measure the corrosion rate of magnesium in various acids; and to obtain a quantitative interpretation of the corrosion rates with the help of critical current density measurements. 5 ref.

6-19. **Relationship Between the Anticorrosive Properties of Paint Films and Their Pigment Content.** *Paint, Oil and Chemical Review,* v. 109, Jan. 10, '46, p. 18.

Pigments examined included white lead, zinc oxide, lithopone, titanium dioxide, antimony oxide, litharge, red lead, zinc yellow, talc, and others. Vehicles consisted of a variety of binders. Paints were applied to iron and magnesium alloy panels and immersed in tap water and a 3% salt solution. Effect of the so-called anticorrosive pigments was minor in comparison with the protection afforded by the various vehicles tested. (Abstract from *Fette & Seifen,* v. 51, 1944, p. 134-143.)

6-20. **Stress-Corrosion Cracking of Mild Steel. Part IV. Development of the "Free Nitrogen Factor".** James T. Waber, Hugh J. McDonald and Bruce Longtin. *Corrosion and Material Protection,* v. 3, Feb. '46, p. 13-20, 24.

Arguments for the assumption that nitrogen is the direct cause of stress-corrosion. Low carbon contents lead to precipitation, but higher contents exert a retarding effect on the precipitation of iron nitride. Increased oxygen and phosphorus increase the aging and cracking susceptibilities by reducing the aluminum available for tying up the nitrogen; cracking times and the extent of aging can be correlated with one another and each can be correlated with the "free nitrogen factor". The resulting

correlation coefficients are each beyond the 1% level of significance. Development of the "free nitrogen factor" and the demonstration of the retarding influence of carbon are important evidence in support of the accelerated precipitation theory. 51 ref.

6-21. **Corrosion Primer.** *Corrosion and Material Protection,* v. 3, Feb. '46, p. 22-24.

Investigation of the factors affecting soil corrosion and the relative behavior of various commercial materials under soil conditions, instituted in 1922 by the National Bureau of Standards. With the aid of the U. S. Department of Agriculture 47 soils in the United States were selected as representative of the soils existing in various parts of the country where extensive installations of pipe had been made.

6-22. **The Corrosion of Metals. Part I. Factors Affecting Corrosion.** *Sheet Metal Industries,* v. 23, Feb. '46, p. 309-320, 334.

Factors which influence corrosion: electrode potential of the metal; over-voltage; polarization; impurities in the metal; condition of the surface of the metal; acidity of the solution; oxygen in the solution; temperature movement of the corroding medium; other ions in solution; conductivity of the solution; stray currents; deposits; humidity.

6-23. **Corrosion Criteria—Their Visual Evaluation.** Marc Darrin. *American Society for Testing Materials Bulletin,* no. 138, Jan. '46, p. 37-39.

Standardized terms and procedures for describing and reporting various types of aqueous corrosion, particularly when of a localized nature. Description of laboratory report forms and how they are used to obtain and interpret corrosion scores, chiefly by visual inspection. Method is simple and can be learned quickly. 7 ref.

6-24. **Some Theoretical Aspects of Season or Stress-Corrosion Cracking.** J. C. Chaston. *Metal Treatment,* v. 12, Winter, '46, p. 242-244, 290.

Theoretical aspects of the stress-corrosion of brasses and aluminum alloys. (Papers presented at a Symposium on Stress-Corrosion Cracking under the auspices of the American Society for Testing Materials and the American Institute of Mining and Metallurgical Engineers.)

6-25. **Failure of Spring Loops by Stress Corrosion.** Given Brewer and Herman Ihsen. *Metal Treatment,* v. 12, Winter, '46, p. 261-262, 271.

Experiment shows that hydrochloric acid causes the cracking. (Abstracted from *Metal Progress,* April, 1945.)

6-26. **Corrosion Resistance.** Morris Cohen. *Iron and Steel,* v. 19, Feb. '46, p. 75-76.

Apparatus for measuring the corrosion resistance of metals in solutions which gives good reproducibility; effect of three different waters on steel. (Paper presented to the Electrochemical Society.)

6-27. **Methods of Assessment of Anti-Fouling Compositions.** K. A. Pyefinch. *Iron and Steel Institute Advance Copy,* Jan. '46, 15 p.

The colonization of a toxic surface immersed in the sea is dependent upon a number of factors, of which the most important may be termed the seasonal and the sensitivity factors. The former, imposed by the limited length of the breeding season of many marine organisms, expresses the availability of settling stages, spores or larvae, for settlement; the latter, produced by the varying sensitivities of these settling stages to the poisons released from the paint, governs the ability of the spores or larvae to settle and develop. Gives an account of a method of assessment which attempts to allow for these factors. 5 ref.

6-28. **Corrosion.** M. G. Fontana. *Ohio State University Engineering Experiment Station News,* v. 18, Feb. '46, p. 27-31.

General discussion of types of corrosion and methods of combating them.

6-29. **Corrosion Resistance of a Hard-Facing Alloy Suitable for Poppet Valves.** F. H. Kelly. *Ohio State University Engineering Experiment Station News,* v. 18, Feb. '46, p. 32-38.

Tests carried out in laboratory engines, then in several types of engines operating under widely varying conditions. Includes test data.

6-30. **Magnesium Gives High Cathodic Protection to Pipelines and Buried Structures.** L. M. Oldt. *National Petroleum News,* v. 38, March 6, '46, p. R186-R187.

Flume built of steel piling driven 14 ft. into the earth was expected to withstand corrosion for only five years. Magnesium anodes installed for cathodic protection have extended the life expectancy to an indefinitely long period; have been found to offer superior properties as galvanic anodes for this type of protection. When properly installed, as much as 500 ampere-hours of electricity have been realized per pound of magnesium consumed at the anode, compared, for example, with 373 ampere-hours for a zinc anode. Longer life and efficiency of the magnesium anodes have been achieved by developing new types of backfill—the electrolyte used around the anode.

6-31. **Stop Tube Failure in Superheater by Adding Corrosion Inhibitors.** *National Petroleum News,* v. 38, March 6, '46, p. R192, R194, R196-R197, R199.

A unique case of severe hydrocarbon-side corrosion of 18-8 alloy furnace tubes in which failures were experienced after only 120 hr. of operation. This corrosion occurred in a superheater furnace in which a 200 to 400° F. boiling range naphtha was cracked in vapor phase for the production of butadiene.

6-32. **The Corrosion of Metals. Part II. Types of Corrosion.** *Sheet Metal Industries,* v. 23, March '46, p. 527-532.

Direct oxidation; thin films; atmospheric exposure; oxidation at high temperatures; dezincification; mechanism of dezincification; electrolytic corrosion; galvanic couple corrosion; electrode potentials in sea water; other operative factors; limitations of cathodic protection; two metals exposed to two different solutions.

6-33. **The Protective Value of Lead and Lead-Tin Deposits in Steel.** A. H. Du Rose. *Electrochemical Society Preprint* 89-7, April 15, '46, p. 101-112.

Corrosion protective value of lead and lead-tin deposits on steel; comparisons between different methods of testing; effect of thickness of deposit and concentration and nature of the addition agent in the plating bath; throwing power of the baths and effect of the metal undercoat on corrosion resistance.

6-34. **Corrosion of Steels.** *Corrosion and Material Protection,* v. 3, March '46, p. 9-12.

Comparison of corrosion resistance of copper steels and of irons and plain carbon steels; corrosion resistance of Cor-Ten and other low-alloy, high-strength steels relative to that of copper or carbon steels; nonmetallic coatings as preventives of corrosion of steels. 11 ref.

6-35. **Stress-Corrosion Cracking of Mild Steel. Part V. Development of Experimental Procedure.** James T. Waber and Hugh J. McDonald. *Corrosion and Material Protection,* v. 3, March '46, p. 13-20.

Evolution of the present testing methods and a brief résumé of typical results. Experimental procedure consists of preparing, heat treating, loading, immersing and inspecting the test specimens. Shape of specimen chosen for convenience, for minimum equipment, and primarily for a large area of constant stress. Solution selected for its effectiveness and low general corrosiveness. An analysis of the stresses in the strained and in the slightly cracked specimen is given and experimentally checked. 16 ref.

6-36. **Chemical Propellants.** Frederick Bellinger, H. B. Friedman, W. H. Bauer, J. W. Eastes and W. C. Bull. *Industrial and Engineering Chemistry,* v. 38, March '46, p. 310-320.

Commercial steel drums were found satisfactory for shipment and storage of permanganates. For use with concentrated (80 to 90%) hydrogen peroxide, all surfaces required preconditioning by an acid wash followed usually by a peroxide soak. After such conditioning, Pyrex, aluminum 99.6%+, aluminum-magnesium alloys, tin, tantalum, cadmium, stainless steel Types 304 and 316 are suitable materials of construction for process equipment; Pyrex and aluminum 99.6%+ are satisfactory for storage containers.

6-37. **Rust Determination in Presence of Steel.** Frank Gibadlo. *Iron Age.* v. 157, April 18, '46, p. 58-59.

Preferential solvent and its application for the identification and estimation of rust and hydrous ferric oxide in the presence of steel. Solubility of the steel in this solvent is determined and found to be 0.1 mg. per 100 ml. at 68° F. Freshly precipitated hydrous ferric oxide is dissolved in the solvent and quantitatively determined, and a quantity as low as 0.01 mg. (as Fe) is determined. Additional data presented to show effect of solvent concentration on the solubility of rust.

6-38. **The Corrosion of Metals. Part II—Types of Corrosion.** *Sheet Metal Industries,* v. 23, April '46, p. 731-736.

One metal in two dissimilar solutions; intercrystalline attack; intercrystalline corrosion under the influence of stress; impingement attack; corrosion fatigue.

6-39. **Corrosion Resisting Properties of Electrodeposited Tin-Zinc Alloys.** R. M. Angles and R. Kerr. *Engineering,* v. 161, March 29, '46, p. 289-292.

Corrosion tests on electrodeposited tin-zinc alloys of various compositions and thicknesses have been undertaken to determine the most suitable type of deposit for protecting iron and steel from rusting.

6-40. **Advanced Metal Preservation Methods.** Irwin H. Such. *Steel,* v. 118, April 29, '46, p. 90-92, 133-134.

Methods employed by the Navy involving the use of chemical dehumidifying agents, rust inhibitors and metal and plastic coverings undoubtedly will provide industry with many new ideas for improved packaging and storage of equipment.

6-41. **Stress-Corrosion Cracking of Mild Steel. Part VI.** James T. Waber and Hugh J. McDonald. *Corrosion and Material Protection,* v 3, April '46, p. 13-18.

Removal of nitrogen eliminates the stress-corrosion tendency and reintroduction of nitrogen restores the susceptibility. Small additions of aluminum and titanium considerably increase the cracking times. This increase in resistance is in agreement with the ability of these elements to form nitrides more stable than iron nitride. These elements act as "nitrogen scavengers".

6-42. **Effect of Composition and Environment on Corrosion of Iron and Steel.** C. P. Larrabee. *Corrosion and Material Protection,* v. 3, April '46, p. 18.

Corrosion resistance of low-alloy steels in the atmosphere and in fresh and sea water. (From paper for American Society for Metals.)

6-43. **The Relative Corrosion Resistance of Magnesium Alloys in Salt Water.** L. W. Eastwood, F. W. Fink and James A. Davis. *Light Metal Age,* v. 4, April '46, p. 16-18, 42.

Alloys of high purity (0.001% iron or less) have markedly improved resistance to salt-water corrosion regardless of zinc content. At iron contents near 0.015%, representative of commercial purity, none of the alloys, regardless of the zinc content, can be regarded as resistant to salt-water corrosion. In the H. T. A. condition all four alloys of commercial purity appear to have similar resistance to salt-water corrosion, but in the as-cast and heat treated conditions, the alloys containing 0.4% zinc have slightly higher corrosion rates than those containing 2 or 3% zinc.

6-44. **Resistance of Nickel-Containing Alloys to Corrosives Encountered in the Petroleum Refineries.** B. B. Morton. *Transactions of the American Society of Mechanical Engineers,* v. 68, April '46, p. 229-235.

Production of bulk gasoline in a modern petroleum refinery is accompanied by corrosion during topping and cracking from sulphur and from weak hydrochloric acid which is formed from salts in the crude. Organic acids such as naphthenics are also often present and are quite corrosive. Solutions of refinery corrosion problems are considered.

6-45. **Corrosion of Light Alloys.** *Metal Progress,* v. 49, May '46, p. 1028-1034.

A summary of papers which appeared in *Korrosion und Metallschutz,* v. 20, March 1944, and *Aluminium,* no. 4, 1943.

6-46. **Electrolytic Corrosion of Fourdrinier Wire Seams.** *Paper Industry and Paper World,* v. 28, April '46, p. 53-56.

Advantages of silver-soldered seam; electrolytic corrosion; effect of corrosion; causes of corrosion; observations; deceiving factors; significant signs; further tests.

6-47. **Corrosion Resistance of Chromium-Plated and Surface-Conditioned 13% Chromium Steel.** Walter E. Moline. *Monthly Review,* v. 33, April '46, p. 401-405, 408.

Variables studied included surface finish, passivation and chromium plating. Corrosion resistance was measured by exposure to the salt spray test and to gasolines saturated with water or salt solution. Atmospheric corrosion tests were also initiated, but have not yet yielded sufficient data for inclusion.

6-48. **Chromate Corrosion Inhibitors in Chloride Systems.** Marc Darrin. *Industrial and Engineering Chemistry (Industrial Edition),* v. 38, April '46, p. 368-373.

The chromate inhibition of monometallic ferrous systems is reported in the presence of chloride in amounts commonly encountered in water-cooling systems. Data show the rate of consumption of chromate at different maintained concentrations and changes in the rate with passage of time. Advantage is shown of starting with a comparatively high concentration of chromate and maintaining it until the protective film is stabilized.

6-49. **Corrosion Testing in a Chemical Plant.** S. W. Shepard. *Chemical & Metallurgical Engineering,* v. 53, April '46, p. 217-228.

Importance of conducting individual corrosion tests for each specific problem. Procedure followed at author's laboratory.

6-50. **Improving Corrosion Resistance on Zinc Alloy Die Castings.** *Die Casting,* v. 4, May '46, p. 68-70.

Yellow "Anozinc" treatment used at the Weatherhead Co., besides improving corrosion resistance, colors zinc alloy die castings to match brass fittings.

6-51. **Corrosion in Crevices.** E. H. Wyche, Lorraine R. Voigt and F. L. LaQue. *Electrochemical Society Preprint* 89-23, April 15, '46, p. 265-278.

Nature of corrosion in crevices and its occurrence; sea water tests on various crevice-sealing compounds—petrolatum is most effective; practical suggestions for avoiding crevice corrosion.

6-52. **Corrosion Resistance of Stainless Steels.** Jurii M. Margolin, Cecily M. Sachnovitch and Pauline I. Jusvinskaya. *Iron Age,* v. 157, May 23, '46, p. 50-55.

Results of decarburization tests on high carbon, 13% chromium steels, conducted by Russian investigators, with the twofold intention of removing carbon from surface

layers to obtain good corrosion resistance and retaining carbon in the core to preserve the strength of the steel.

6-53. **Corrosion Criteria a Visual Scoring Method.** M. Darrin. *Metal Industry,* v. 68, May 3, '46, p. 351-352.

Standardized terms and procedures for describing and reporting various types of aqueous corrosion suggested. (Paper for American Society for Testing Materials.)

6-54. **Rust Not—Want Not.** D. H. Killeffer. *Scientific American,* v. 174, April '46, p. 161-163.

Of various methods of protection against the ravages of corrosion, inhibitive treatment offers simplicity and wide applicability.

6-55. **Relation of Strain Aging to the Stress-Corrosion Cracking of Mild Steel.** James T. Waber and Hugh J. McDonald. *Welding Journal,* v. 25, April '46, p. 223s-234s.

Review of the researches on age hardening, strain aging, boiler embrittlement and stress-corrosion revealed a number of similarities. All of these similarities are interpreted in light of the proposed accelerated precipitation theory of stress-corrosion. Previous work pointed to nitrogen as a possible cause of stress-corrosion cracking. Importance of nitrogen was confirmed in two ways—by the development of the "free nitrogen factor" and the demonstration that the removal followed by the reintroduction of nitrogen caused the loss and the reinstatement of the cracking tendency, respectively. 90 ref.

6-56. **Stress-Corrosion With Steel Bottles for Compressed Gas.** H. de Leiris, J. Couture and C. Crussard. *Metallurgia,* v. 33, April '46, p. 326-327.

Complete analysis of the mode of propagation of flaws developing from incipient cracks. Causes are localized fault, poor quality of metal, or, most often, stress-corrosion under tension. (From *Metaux-Corrosion-Usure,* Nov.-Dec. 1944.)

6-57. **Atmospheric Corrosion Tests on High-Chromium Steels.** W. O. Binder and C. M. Brown. *American Society for Testing Materials Preprint* 47, 1946, 16 p.

Data on atmospheric corrosion tests based on the weight-loss method, for low-carbon, 0 to 18% chromium steels. The test data show a progressive improvement in atmospheric corrosion resistance with increasing chromium content and indicate that an addition of 18% chromium is required to make the steels virtually stainless in the atmospheres tested.

6-58. **Atmospheric Corrosion Tests of Corrosion Resistant Steel Wires.** A. P. Jahn. *American Society for Testing Materials Preprint* 49, 1946, 3 p.

Nature and results of atmospheric corrosion tests on wire and wire product specimens of corrosion resistant steel after exposure for about nine years at test sites of various types, including severely industrial, mildly industrial, seacoast, and rural.

6-59. **Corrosion Resistant Steel Sheet in Marine Atmospheres.** Willard Mutchler. *American Society for Testing Materials Preprint* 50, 1946, 19 p.

Thin corrosion resistant steel sheets were exposed to the weather for periods up to three years, in marine atmospheres. Information was obtained regarding some effects upon corrosion of factors such as the presence of small quantities of stabilizing elements in steels containing approximately 18% chromium and 8% nickel; locality of exposure; shotwelding; surface finishes and treatment; and contact with light metal alloys.

6-60. **Weathering Behavior of Corrosion Resistant Steel Insect Screens.** W. A. Wesley and H. R. Copson. *American Society for Testing Materials Preprint* 52, 1946, 14 p.

Results of several series of atmospheric corrosion tests in which commercially woven wire-cloth screens of bronze, 18% chromium, 8% nickel corrosion resistant steel, and type 316 corrosion resistant steel were exposed in sulphurous, industrial, marine, and rural atmospheres.

6-61. **The Corrosion of Metals. Part III—Corrosion Testing.** *Sheet Metal Industries,* v. 23, May '46, p. 933-940.

The problem of corrosion testing as a whole; difficulties that arise; precautions that must be taken and the importance which attaches to the interpretation of the results when the test is finished.

6-62. **Water Analysis in Cycling Fields Yields Information on Corrosion.** *Corrosion and Material Protection,* v. 3, May '46, p. 12, 11.

Samples obtained from 14 corrosive fields, 10 noncorrosive fields, and 12 fields on which available operating information was insufficient to determine whether or not a corrosive condition existed. Maximum values, minimum values, and average values of data obtained are shown.

6-63. **Stress-Corrosion Cracking of Mild Steel. Part VII. Preventive Treatments.** Robert D. Misch, James T. Waber, and Hugh J. McDonald. *Corrosion and Material Protection,* v. 3, May '46, p. 13-19.

Nature of stress corrosion; removal of factors causing it; stress relief by various methods.

6-64. **The Corrosion Resistance of Aluminum and Its Alloys.** Ronald B. Spacht. *Journal of Chemical Education,* v. 23, May '46, p. 253-257.

Chemical attacks, also electrolytic or galvanic corrosion of aluminum and conditions which might lead to latter. Table gives summary of corrosion resistance properties of aluminum.

6-65. **Combatting Corrosion.** *National Petroleum News,* v. 38, June 5, '46, p. R450, R452-R454.

Selenium rectifiers for cathodic protection; magnesium anodes for the cathodic protection of underground structures; neutralizing circuit for elimination of long line current corrosion; results obtained from five years of cathodic protection on 24-in. gas line rapidly deteriorating from bacterial corrosion; use of fibrous glass in underground pipe protection; the installation and protection of underground gas distribution systems with pipe line enamels; corrosion in cooling water systems and service lines; designing to prevent corrosion; designing water pipe for long life and high carrying capacity.

6-66. **The Corrosion of Metals. Part III—Corrosion Testing.** *Sheet Metal Industries,* v. 23, June '46, p. 1145-1146, 1159.

Atmospheric tests; spray tests; total immersion tests; alternate immersion and partial immersion tests; books on corrosion testing. 4 ref.

6-67. **Corrosion of Steel by Gaseous Chlorine.** Gustave Heinemann, Foster G. Garrison, and Paul A. Haber. *Industrial and Engineering Chemistry (Industrial Edition),* v. 38, May '46, p. 497-499.

Information is presented on the rate of corrosion and the ignition temperature of sheet steel in commercially dry chlorine gas at temperatures from 77 to 251° C. for exposure periods between 12 and 480 min. Gradual increases in the corrosion rate are noted as the temperature is raised to 248° C. At 251° the sheet coupons show a greatly accelerated corrosion rate of approximately 31 in. penetration per year for exposure periods of less than 30 min. After 30 min. exposure at 251° C. the sheet steel coupons ignite to give corrosion rates in excess of 170,000 mg. per sq. dm. per day.

6-68. **How Cathodic Protection Prevents Pipe and Tank Corrosion.** *Power Plant Engineering,* v. 50, June '46, p. 83-85, 90.

Theory of cathodic protection; advantages; the cathodic protection battery; preliminary steps to installation; conducting a current survey for a pipe line; test points; pipe-to-soil potential; current required for protection; ground beds; current sources; current density requirements for tanks; effect of ice on corrosion; record of protection system for a tank; costs.

6-69. **Reaction of an Aluminum-Magnesium Alloy With Water Vapor and Hydrogen.** R. Eborall and C. E. Ransley. *Engineering,* v. 161, May 10, '46, p. 438-439.

Effect of corrosion films on the true and apparent gas content.

6-70. **The Resistance to Corrosion by Sea Water of Some α-Tin and α-Tin-Aluminum Bronzes.** J. W. Cuthbertson. *Journal of the Institute of Metals,* v. 72, May '46, p. 317-342.

Resistance of alloys to impingement corrosion, to deposit attack, and to simple immersion corrosion has been examined and compared with that of cupronickel and aluminum brass. Resistance to impingement corrosion demands primarily a high content of tin. Simple prefilming process developed, by means of which resistance of bronzes to impingement and general corrosion can be improved. Comparative tests on alloys prepared by normal methods of casting and from degassed melts, and on materials having variable and controlled grain size, have established the importance of homogeneity of structure and fineness of grain size in combating impingement attack.

6-71. **Rates of High-Temperature Oxidation of Magnesium and Magnesium Alloys.** T. E. Leontis and F. N. Rhines. *Metals Technology,* v. 13, June '46, T. P. 2003, 28 p.

Linear oxidation of pure magnesium and a series of magnesium alloys has been measured within a temperature range of 412 to 575° C., where a loose oxide scale

forms. Logarithm of the rate is directly proportional to the reciprocal of the absolute temperature. Energy of activation E for the oxidation of magnesium in this range is 50,500 cal. and the action constant A is 6.2×10^{12} mg. per sq.cm. per hr. Alloying increases rate of oxidation of magnesium whenever melting temperature is significantly depressed by the alloying element. Magnesium forms protective oxide film at low temperatures, nonprotective loose scale at higher temperatures, and may undergo combustion at temperatures approaching the melting point.

6-72. **Corrosion of Inserts.** A. J. Ferko. *Metal Industry,* v. 68, June 14, '46, p. 467-468.

Research reported on was to determine which was the best protective coating to be applied to a magnesium casting alloy in order to suppress galvanic corrosion between the alloy and a number of different metals in the form of screwed inserts. Results are given in pictorial and tabular form.

6-73 **Recent Developments in Corrosion Control.** Sheppard T. Powell, H. E. Bacon, and J. R. Lill. *Journal of the American Water Works Association,* v. 38, July '46, p. 823; discussion p. 823-825.

Calcium carbonate scale and control of temperature effects; control of saturation index; cold water de-aeration equipment.

6-74. **The Use of Magnesium Anodes for Cathodic Protection.** L. M. Oldt. *Corrosion and Material Protection,* v. 3, June-July '46, p. 12-14.

Magnesium, which combines in one metal a large storage capacity for electricity and a high potential or driving voltage—both desirable characteristics when the anode is to operate galvanically—is recognized as being a suitable material for use in cathodic protection installations. Since experimentation to date has been chiefly confined to protection of pipe lines and other buried structures, there is more data available in this field and emphasis is given to this area of operations.

6-75. **Overvoltage and Its Significance in Corrosion.** Samuel Glasstone. *Corrosion and Material Protection,* v. 3, June-July '46, p. 15-18.

In certain cases overvoltage can play an important part in corrosion phenomena involving a single metal or two different metals (or a metal and a conducting impurity) in contact. A metal of low overvoltage can increase corrosion, whereas a high overvoltage metal may be used to inhibit the corrosion of a base metal.

6-76. **Attack of Various Atmospheres on Copper and Some Copper Alloys at Elevated Temperatures.** A. P. C. Hallowes and E. Voce. *Metallurgia,* v. 34, June '46, p. 95-100.

Eighteen copper-base alloys and five varieties of commercial copper have been tested for resistance to intermittent oxidation and scaling at 400° C. in five different atmospheres, all derived from dry air freed from acid impurities. Work is described and conclusions resulting from the investigation are given.

6-77. **Cathodic Protection of Metals.** *Light Metals,* v. 9, July '46, p. 378-380, 382.

Emphasis is laid on need for adequate assessment of prevailing conditions before adopting one or other of available protective systems. (Review from *Technische Rundschau,* May 17 and May 24, 1946.)

6-78. **Cathodic Protection on Large Diameter Pipe Lines.** N. K. Senatoroff. *Gas Age,* v. 98, July 25, '46, p. 18-19, 56-57.

From the cost study given of coating material involved in providing an additional $\frac{1}{32}$-in. thickness of enamel to the $\frac{3}{32}$-in. average thickness, occasionally specified as satisfactory coating requirement, it is quite apparent that the extra cost is fully justifiable. An expenditure of approximately $200 per mile on the 26-in. line for the improvement of the protective value of the coating is being gradually refunded.

6-79. **The Corrosion of Metals. Part IV. The Corrosion of Iron and Steel.** *Sheet Metal Industries,* v. 23, July '46, p. 1333-1342.

Effects of coupling iron with other metals; intergranular attack of iron and its alloys; intergranular attack of improperly heat treated stainless steel, corrosion fatigue properties of various iron alloys, corrosion of stainless steel.

6-80. **Corrosion Limits Metals That Can Be Used for Construction of HF Alkylation Units.** *National Petroleum News,* v. 38, Aug. 7, '46, p. R618, R620, R622, R624, R626-R628.

Presents a summary of tests on the corrosion of metals by hydrofluoric acid, and correlates the data with actual experience in commercial operations. The material was originally published as Chapter 10 of the recent book "Hydrofluoric Acid Alkylation".

6-81. **Furan Resins in the Plating Industry.** William H. Adams, Jr. *Monthly Review,* v. 33, Aug. '46, p. 830-832.

Value of furan resins to the electroplater lies in the fact that equipment can be made from it which will resist the corrosive effects of practically every plating solution except chromium. Such equipment, including tanks, pumps, pipe and fittings, valves, makes it possible to avoid completely the danger of damage by corrosion.

6-82. **Corrosion—The Archenemy of Line Hardware.** B. J. Barmack. *Electric Light and Power,* v. 24, Aug. '46, p. 58-60.

Several possible methods for prolonging the life of hardware used on electric lines. Poles and arms now have life expectancy of about 30 years, but hardware usually lasts only half that time.

6-83. **A Summary of the Investigation of Drill-Pipe Failures in the Permian Basin.** L. R. Jackson, H. M. Banta, and R. C. McMaster. *Oil and Gas Journal,* v. 45, Aug. 31, '46, p. 75; *Drilling,* v. 7, Sept. '46, p. 30.

Discusses suitable methods for preventing failures; use of inhibitor in drilling muds, protective coatings on inside of pipe and keeping pipe in tension to prevent bending stresses that lead to fatigue failures.

6-84. **Use of Magnesium for Cathodic Protection of the Katy Pipe Line.** Porter Hart and Oliver Osborn. *Petroleum Engineer,* v. 17, Aug. '46, p. 136, 138, 140, 142, 144.

Details of use of magnesium anodes for cathodic protection of an 82-mile pipe line.

6-85. **Corrosion of Underground Structures in Gas Plants.** Charles F. Meyerherm. *Paper delivered at Eighteenth Annual Joint Conference of the Production and Chemical Committees of American Gas Association,* June 1946, 5 p.

General discussion of methods for combatting such corrosion.

6-86. **Corrosion Forum.** O. S. True, Frederick L. Hunter, H. C. Esgar, D. F. Siddall, F. E. Herstein, and C. L. Bulow. *Chemical Engineering,* v. 53, Aug. '46, p. 203-204, 206, 208, 209, 210, 212, 214, 216, 218, 220.

Part II of a symposium designed to outline the usefulness of various representative materials in phosphoric acid service. Contains sections on rubber, tantalum, stainless steel, vinyl-base paints, chemical stoneware, and copper and copper-base alloys. Last section includes tables on corrosion resistance of pure copper and a number of alloys.

6-87. **Magnesium as a Galvanic Anode.** H. A. Robinson. *Electrochemical Society Preprint* 90-4, 1946, 71 p.

Performance characteristics of the magnesium anode studied in the laboratory under carefully controlled conditions of operation. Methods and apparatus used are illustrated and discussed. Effects on anode performance of such variables as current density, anode composition, impurities, electrolyte pH, and electrolyte composition have been investigated and are reported.

6-88. **Attack of Various Superheated Steam Atmospheres Upon Aluminum Bronze Alloys. Part 2.** A. P. C. Hallowes and E. Voce. *Metallurgia,* v. 34, July '46, p. 119-122.

Action of superheated steam on complex aluminum bronzes has been studied as a result of some failures when used industrially in certain superheated steam atmospheres under service conditions involving stress.

6-89. **The Agents, Basic Causes, Control and Prevention of Corrosion. Part 1.** F. A. Prange. *Oil and Gas Journal,* v. 45, Sept. 7, '46, p. 88, 91, 93.

Approaches the subject from the viewpoint of general theory and gives the reasons for different types of corrosion and the various methods for its prevention and control.

6-90. **Intercrystalline Corrosion of Aluminum-Magnesium Alloy Rivets.** G. J. Metcalfe. *Journal of the Institute of Metals,* v. 72, July '46, p. 487-500.

A number of service failures in aluminum alloy rivets containing 7% and 5% of magnesium are attributed to intercrystalline corrosion. Normally aluminum alloy rivets containing 5% of magnesium are not susceptible to intercrystalline corrosion but when they are subjected to tropical temperatures for long periods precipitation of the β phase occurs, which renders them susceptible to intercrystalline attack. Cold working is found to facilitate grain-boundary precipitation. Low-temperature stabilizing treatments are unsatisfactory. Corrosion tests show

that in rivets that have been previously heated at 70° C. for 14 days intercrystalline corrosion occurs at the junction of the shank and the head.

6-91. **Corrosion of Ferrous Materials.** C. P. Larrabee. *Steel,* v. 119, Sept. 9, '46, p. 134.

Results of tests reported before February meeting of American Society for Metals (Lecture Course on Corrosion) indicate that corrosion rate is mainly dependent upon length of time surface is moist, amount and nature of atmospheric contaminants, and composition of steel.

6-92. **Cathodic Protection Stops Tank Corrosion.** *Railway Engineering and Maintenance,* v. 42, Sept. '46, p. 941-942.

Chesapeake & Ohio has installed cathodic protection in 48 of its 148 steel water service tanks. With this method of electrical protection, no detrimental effects have been observed, interior corrosion below the water level has been stopped and substantial savings are reported compared with the cost of repainting the interiors of the tanks below the water level.

6-93. **Preserving Artillery Pieces.** W. H. Walter. *Steel,* v. 119, Sept. 16, '46, p. 100-102, 127-128, 130.

Low-cost procedures used in preparing heavy gun parts for long-term storage in welded steel containers.

6-94. **Learn the A-B-C's of Corrosion if You Would Get Longer Life From Your Equipment.** F. A. Prange. *Oil and Gas Journal,* v. 45, Sept. 14, '46, p. 88-90, 92.

Discusses and illustrates various types of corrosion and ways of preventing or minimizing it with particular reference to oil-field equipment.

6-95. **Failures of Domestic Hot Water Storage Tanks.** Charles P. Hoover. *Journal of the American Water Works Association,* v. 38, Sept. '46, p. 1005-1011.

Discusses experimental corrosion control work and gives general conclusions. Various protection methods and contributing causes of failures. 10 ref.

6-96. **Corrosion of Galvanized Hot Water Storage Tanks.** J. M. Bialosky. *Journal of the American Water Works Association,* v. 38, Sept. '46, p. 1012-1017; discussion p. 1017-1020.

Factors which can be controlled by the manufacturer and those which cannot; gives recommendations for obtaining maximum service life. 11 ref.

6-97. **The Electrochemical Mechanism of Certain Corrosion Processes and Its Practical Implications.** U. R. Evans. *Corrosion and Material Protection,* v. 3, Aug-Sept. '46, p. 15-18.

Dry oxidation; electrochemical attack; pitting due to mill scale; electrochemical mechanism of natural corrosion; soluble inhibitors; inhibitive pigments; metallic coatings; passivity. 26 ref.

6-98. **Insulation of Dissimilar Metal Faying Surfaces.** W. Floersch. *Automotive and Aviation Industries,* v. 95, Oct. 1, '46, p. 37, 88, 90.

Tests are designed to show comparative corrosion resistance of definite dissimilar metal contacts having vari-

ous organic finishing schemes. Among dissimilar metals studied were: 24S-T duralumin with cadmium-plated 1025 steel, AMC52S-H magnesium with 18-8 stainless steel, AMC52S-H magnesium with 24S-T duralumin and AMC52S-H magnesium with 24S-T alclad. Requirements varied from one to three coats of zinc chromate primer.

6-99. **Phosphoric Acid Vs. Materials of Chemical Plant Construction—Part III.** *Chemical Engineering,* v. 53, Sept. '46, p. 203-204, 206, 208, 210, 212, 214.

Final portion of symposium evaluates corrosion resistance of Durimets T and 20; nickel, nickel alloys; lead; Haveg; carbon, graphite, Karbate; high-silicon iron; and vitreous silica for phosphoric acid service.

6-100. **Atmospheric Corrosion Tests on High-Chromium Steels.** W. O. Binder and C. M. Brown. *Steel Processing,* v. 32, Sept. '46, p. 565-571, 594-595.

Quantitative data on marine and industrial atmospheric corrosion tests on a series of steels containing additions of chromium in amounts from 0 to 18%. Results of atmospheric corrosion tests on cold rolled austenitic chromium-nickel and chromium-manganese-nickel steels of the type suitable for lightweight construction.

6-101. **Corrosion in Vertical Turbine Pumps.** T. E. Larson. *Power Plant Engineering,* v. 50, Sept. '46, p. 80-81, 109-110.

Water level recession; corrosion due to galvanic action; when CO_2 causes corrosion; corrosion caused by stray currents; acid treatment.

6-102. **Effect of Corrosion on Spot Welded 75S-T Alclad Alloy.** Mario L. Ochieano. *Product Engineering,* v. 17, Oct. '46, p. 126-128.

Improper material preparation and welding techniques result in erratic bonding in the corona area of 75S-T alclad spot welds. This nonuniform bonding is affected by salt spray resulting in an inconsistent reduction of shear strengths. Results of tests showing these results, as well as data from tension specimens and data on the preparation and welding of specimens.

6-103. **Corrosion of Yellow Brass Pipes in Domestic Hot Water Systems—a Metallographic Study.** E. P. Polushkin and Henry L. Shuldener. *Corrosion,* v. 2, March '46, p. 1-19.

Results of microscopic examination of a series of brass pipes removed from apartment and office buildings. They were selected as typical of approximately 400 specimens obtained over a period of five years. A part of the investigation is reported in this paper and includes a brief history of the pipes, a description of their inside surface and microstructure, and a study of the effects of corrosion, with particular reference to the structural aspects of local and selective dezincification. 21 ref.

6-104. **Control of Galvanic Corrosion of Iron.** C. K. Donoho and J. T. MacKenzie. *Corrosion,* v. 2, March '46, p. 20-24.

Causes of galvanic corrosion in iron and steel structure and in fusion welds. Shows how polarity of welds may be determined by the "agar test" and how iron may be protected against corrosion by alloying with nickel or copper.

6-105. **Control of Pipe-Line Corrosion—a Manual. Part II (Concluded).** O. C. Mudd. *Corrosion,* v. 2, March '46, p. 25-58.

Complete details of cathodic protection techniques and of pipe coatings, their application and protection. Includes many diagrams showing how to install the protection systems.

6-106. **Corrosion Problems in the Petroleum Production and Pipe Line Industry.** Walter F. Rogers. *Corrosion,* v. 2, March '46, p. 59-63.

Outlines the various research investigations which have been and are being carried on in recent years on corrosion of pipe lines, refinery equipment and oil well pipe and equipment. Latter problem is being investigated by a group at Battelle Memorial Institute.

6-107. **The Corrosion of Metals. Part IV—The Corrosion of Iron and Steel. (Continued.)** *Sheet Metal Industries,* v. 23, Sept. '46, p. 1756-1757, 1768.

Corrosion fatigue of steel; effect of chemical composition; effect of metallurgical properties; avoiding corrosion fatigue; corrosion fatigue of stainless steels.

6-108. **Some Stress-Corrosion Studies on Austenitic Cast Irons.** J. B. Urban, J. W. Bolton, and A. J. Smith. *Transactions of the American Society of Mechanical Engineers,* v. 68, Aug. '46, p. 633-636.

At very high stresses the austenitic cast irons are subject to stress-corrosion in strong hot caustic. However, threshold stresses have been found to be relatively high, markedly exceeding stresses contemplated in design and application. Thus the desirable properties of such material can be utilized to good advantage, with margin to assure adequate safety in this corrosive medium. Composition of the materials examined is given in table.

6-109. **Corrosion in the Water Industry.** H. Arthur Price. *Corrosion,* v. 2, June '46, p. 95-100.

Water meter corrosion, cavitation and graphitization; prevention.

6-110. **New Developments to Combat Corrosion in Paper and Pulp Industries.** K. P. Chamberlain. *Paper Trade Journal,* v. 123, Oct. 10, '46, p. 126, 130.

Use of Neoprene, Nitrocote, and Durofilm as coating materials, and a rubber pipe joint which eliminates the present flanged fabricated pipe and fittings.

6-111. **Corrosion of Plant Equipment by Steam and Water. Part 1.** R. C. Ulmer. *Power Plant Engineering,* v. 50, Oct. '46, p. 72-75, 91.

Characteristics of various types of corrosion; mechanism of corrosion and chemical reactions involved; effects of acid and alkaline solutions; how surface condition modifies corrosive attack; effects of metallic deposit on surface; variation in attack due to temperature changes; causes of embrittlement; methods employed for preventing corrosion and embrittlement in modern steam power plants.

6-112. **Telephone Cable-Sheath Corrosion in Non Stray Current Areas.** J. M. Standring. *Corrosion,* v. 2, Sept. '46, p. 133-137.

Test methods used to determine the location of places where corrosion is likely to occur. Method for locating the anodes and cathodes in non stray current areas involves measurement of earth gradients around the cable. Half cells are used instead of lead electrodes for the earth contacts.

6-113. **Laboratory Studies for Determination of Organic Acids as Related to Internal Corrosion of High Pressure Condensate Wells.** E. C. Greco and H. T. Griffin. *Corrosion,* v. 2, Sept. '46, p. 138-151; discussion, p. 151-152.

Electrometric titration analyses of samples of waters from these wells, to determine the amount of organic acids present, believed to be responsible for much corrosion. 9 ref.

6-114. **Designing Water Pipes for Long Life and High Carrying Capacity.** Gairald H. Garrett. *Corrosion,* v. 2, Sept. '46, p. 153-162.

Methods of increasing the service life of water pipelines for mildly corrosive conditions for more severe and for very severe corrosive conditions.

6-115. **Mechanical and Metallurgical Control of Sulphuric Acid Corrosion in Petroleum Processes.** Condensation of paper by E. R. Wilkinson. *Oil and Gas Journal,* v. 45, Oct. 12, '46, p. 96.

Discusses the various factors influencing sulphuric acid corrosion, including effects of different acid strengths on various common metals and alloys, and ways of minimizing the corrosion in refinery equipment. (Presented at A.S.M.E. Conference on Petroleum Mechanical Engineering.)

6-116. **Corrosion of Refinery Equipment.** Condensation of paper by E. E. Kerns. *Oil and Gas Journal,* v. 45, Oct. 12, '46, p. 96.

Factors in corrosion caused by the constituents of the crudes and ways to minimize them by chemical treatment and use of special alloys. (Presented at A.S.M.E. Conference on Petroleum Mechanical Engineering.)

6-117. **Corrosion Inhibitors.** *Metallurgia,* v. 34, Sept. '46, p. 270-273.

Review of some of the papers presented at the symposium on inhibitors for control of scale and corrosion in water held recently before meeting of the American Chemical Society in New York.

6-118. **The Corrosion of Metals. Part V. The Corrosion of Tinplate. (Continued.)** *Sheet Metal Industries,* v. 23, Oct. '46, p. 1951-1960.

Brief outline of the behavior of different types of iron with special reference to the conditions likely to obtain in tin cans. Considers the relative merits from the point of view of corrosion of hot-dipped and electrodeposited tin, and also the relative corrosion resistance of tinplate compared with untinned lacquered steel.

6-119. **Cathodic Protection as a Corrosion Control Method Applied to Steel Surfaces Submerged in Water.** L. P. Sudrabin. *Corrosion,* v. 2, Oct. '46, p. 175-187.

Fundamentals; use of surface coatings; electrode design and material; several large applications. 13 ref.

6-120. **Magnesium Anodes for the Cathodic Protection of Underground Structures.** H. A. Robinson. *Corrosion,* v. 2, Oct. '46, p. 199-218.

Outlines a program of experimental field work to determine how magnesium would perform as a sacrificial anode, and to evaluate what advantages it might offer for the practice of cathodic protection. Magnesium anodes containing 6% Al and 3% Zn are recommended for certain electrical conditions. Laboratory and field results tend to approach each other as improvements indicated by the former are incorporated in the latter.

6-121. **Discussion of Article on Stress-Corrosion Cracking.** Geo. F. Comstock. *Welding Journal,* v. 25, Oct. '46, p. 699s, 728s.

Article referred to is by Waber and McDonald and was published in the April issue. Comstock finds it difficult to accept the theory that nitrogen in steel is the cause of strain aging, caustic embrittlement and stress-corrosion cracking. Authors' reply is included.

6-122. **Quantitative Evaluation of Intergranular Corrosion of 18-8 Ti.** Freeman J. Phillips. *American Society for Metals Preprint,* no. 6, 1946, 16 p.

Survey made of the detection, cause, and methods of elimination of intergranular corrosion in 18-8. Quantitative method for predicting intergranular corrosion of 18-8 Ti developed for a given set of conditions. In deriving this method, an explanation was found for the corrosion of 18-8 Ti in which the titanium content exceeded the stoichiometric ratio of four times the carbon content. Method is based on microstructure and chemical composition and is thought to be applicable to other grades of stainless steels.

6-123. **Corrosion Resistance of Magnesium and Certain of Its Alloys Under Various Accelerated Atmospheric Conditions.** R. R. Rogers, D. A. Tetu, and H. Livingstone. *Electrochemical Society Preprint* 90-25, 1946, 8 p.

Investigation to determine the corrosion resistance of commercially pure magnesium and of the magnesium alloys AZ 31 X, AZ 61 X, and M-1, by the use of accelerated tests. The conditions to be represented in the tests were inland indoor atmospheric, inland outdoor atmospheric, and marine atmospheric. Experimental results indicate good resistance to corrosion under the third condition. It is pointed out that most metals should resist marine atmospheric conditions satisfactorily when properly protected with paint.

6-124. **Corrosion of Constructional Materials by Sulphur and Sulphides.** James R. West. *Chemical Engineering,* v. 53, Oct. '46, p. 225-226, 228, 230, 232, 234, 236, 238.

Results of investigation to determine present state of knowledge on corrosion by sulphur and sulphides, especially molten sulphur and sulphur vapor. Literature was surveyed and information was solicited from 135 industrial concerns, including both users and producers of constructional materials. Report is a digest of all the information so obtained; most of it has not been published before.

6-125. **Accelerated Corrosion Testing of Protective and Decorative Coatings.** R. R. Rogers. *Canadian Chemistry and Process Industries,* v. 30, Oct. '46, p. 91-94.

Factors controlling corrosion rates; various types of corrosion testing equipment, and its applicability to different problems. (Presented at the annual conference of the Chemical Institute of Canada.)

6-126. **Stress-Corrosion of Austenitic Cast Irons.** John B. Urban, John W. Bolton, and Austen J. Smith. *Foundry,* v. 74, Nov. '46, p. 88-90, 182, 184, 186.

Samples of austenitic cast iron were immersed in 50% caustic at 280° F. while being subjected to long period tensile loading. Resistance wire strain gages were used to determine surface stress intensities. Results are shown graphically and in tables. Studies show that for the corrosive action and temperature considered there is a relatively high limiting stress below which the effects of stress-corrosion on austenitic irons are either negligible or nonexistent. (Presented before sectional meeting of American Society of Mechanical Engineers at Cincinnati.)

6-127. **Use of Corrosion Inhibitors in Products Pipe Lines.** Ivy M. Parker. *Oil and Gas Journal,* v. 45, Nov. 16, '46, p. 255-256, 259.

The practices of the different companies operating these pipe lines were surveyed by the questionnaire method, and the results are summarized. Considers mechanism of inhibition, "carrying distances" of the various inhibitors and methods of determining this factor. 12 ref.

6-128. **Corrodibility of Some Common Metals and Alloys.** *Metal Progress,* v. 50, Nov. '46, p. 884-B.

Corrodibility is tabulated for 56 metals and alloys, with respect to water, seashore and industrial atmospheres, various acids and alkalies, salt solutions, sulphite liquor, dye liquor, and sweet and sour refinery crudes. Also gives maximum safe temperatures with respect to oxidation resistance to three types of gases. (Revised data sheet.)

6-129. **Fedders-Quigan Solve a Problem in Corrosion Engineering.** Norman P. Gentieu. *Products Finishing,* v. 11, Nov. '46, p. 58-59, 62, 64.

"Deoxidine 10E" removes rust and oil effectively from condenser tubing and prevents further formation of rust by means of the protective action of the solution. Gives sequence of operations.

6-130. **Corrosion Is no Accident.** H. E. Smith, Jr. *Mechanical Engineering,* v. 68, Nov. '46, p. 943-948.

Shows the prime importance of inspection and cleanliness in the constant fight against destructive corrosion. Study of corrosion was made on eight C-47 type aircraft that were assigned to the reparable aircraft pool at Biak Air Depot, Biak Island, Netherlands, East Indies. Areas where normal pitting and eating away were experienced were all on alclad sheet. Both types of corrosion, normal eating away or pitting and intercrystalline, were encountered in varying degrees of intensity on all aircraft studied.

6-131. **Corrosion and Preventive Methods in the Katy Field.** R. C. Buchan. *Oil Weekly,* v. 123, Nov. 18, '46, p. 25-28, 31-32, 40.

Effects of acidic-water corrosion. The use of plastic-coated pipe and the use of soda ash as a neutralizing agent are practical means of reducing corrosion losses in the Katy Field. The need for continued research and for field testing of alloys is pointed out.

6-132. **Study Copper Alloys in Sulphur, Water.** Review by D. P. Thornton, Jr. From "A Study of the Corrosion of Copper Alloy Condenser Tubes", by N. W. Mitchell. *Petroleum Processing,* v. 1, Nov. '46, p. 176.

Primary causes of corrosion and results of corrosion as they are visible on the metal. Hitherto unpublished data secured from extensive corrosion tests are tabulated, which indicate comparative resistance of the various alloys to attack by sulphur and water.

6-133. **"Thermogalvanic" Corrosion.** N. E. Berry. *Corrosion,* v. 2, Nov. '46, p. 261-267.

Discussion is largely concerned with copper in contact with acidified cupric salt solution in absence of oxygen. Corrosion in this system occurs only when there is a substantial temperature differential, hence is called "thermogalvanic". Fundamentals of this type of cell and an apparatus for determining potential at a given temperature gradient; possibilities of this type of corrosion with other metals.

6-134. **Corrosion Criteria—Their Visual Evaluation.** Marc Darrin. *Corrosion,* v. 2, Nov. '46, p. 268-272; discussion, p. 273-277.

Visual scoring method for evaluating panel exposure tests in aqueous media. This is necessary because of non-uniform corrosion which often makes weight loss comparisons meaningless.

6-135. **Some Metallurgical Observations With Respect to Corrosion in Distillate Wells.** M. E. Holmberg. *Corrosion,* v. 2, Nov. '46, p. 278-285; discussion, p. 285-286.

Localized corrosion is explained on the basis of variations in metallographic structure brought about during fabrication. Illustrated by photographs and photomicrographs.

6-136. **Impedance of Meter Valves.** H. Johnston. *Gas Journal,* v. 248, Oct. 30, '46, p. 727-728, 731-732.

Results of a metallographic and chemical examination of corroded gas meter valves; causes and possible methods for prevention of the corrosion.

6-137. **Corrosion of Plant Equipment by Steam and Water —II.** R. C. Ulmer. *Power Plant Engineering,* v. 50, Nov. '46, p. 90-92.

Factors in corrosion of steam lines, feed pumps, heaters and economizers. (To be continued.)

6-138. **Special Materials Solved Corrosion Problems at Oak Ridge.** R. J. Schrader and A. De Haan. *Chemical Engineering,* v. 53, Nov. '46, p. 96-100.

Specific situations are described and the suitability of various materials tried and adopted is given. Includes piping, ferrule fittings, gasket materials, high-temperature resistant materials, tanks and vessels, paints and plastic coatings, hoods and ductwork, pumps, and corrosion resistant floors.

6-139. **Chemical and Heat Resistance of Gasket Materials.** H. H. Dunkle and E. C. Fetter. *Chemical Engineering,* v. 53, Nov. '46, p. 102-109.

Gasket constructions in general use and gasket materials both metallic and nonmetallic; their heat and chemical resistance.

6-140. **Chemical Resistance of Constructional Metals and Nonmetals.** *Chemical Engineering,* v. 53, Nov. '46, p. 120-150.

Table shows resistance of materials to 24 common and troublesome chemicals. Also some of the important applications in which the materials are being used.

6-141. **Some Experiences With the Protection of Bare Pipe Lines Using Zinc.** F. A. Brownie. *Gas Age,* v. 98, Nov. 28, '46, p. 19-21, 27.

Costs and results, in terms of a survey of pipe potentials, for anodic protection installation of a natural gas line. Results were satisfactory except in a few instances.

6-142. **Acetic Acid Vs. Materials of Chemical Plant Construction—Part I.** *Chemical Engineering,* v. 53, Nov. '46, p. 253-254, 256, 258, 260, 262, 264.

Part I of a symposium in which manufacturers evaluate their products for acetic acid service. Includes carbon, graphite, Karbate; aluminum alloys; Durimet and Chlorimet; glass-lined steel; silver; tantalum.

6-143. **Relative Effectiveness of Cathodic Protection and Painting in Preventing Corrosion of the Interior of Steel Tanks.** T. W. Hislop, Jr. *American Railway Engineering Association Bulletin,* no. 462, Nov. '46, p. 196-201.

Progress report includes diagrams showing how cathodic protection may be applied to tanks. So far, it has given more effective corrosion prevention than paints.

6-144. **The Corrosion of Metals. Part VI. The Corrosion of Copper and Its Alloys. (Continued.)** *Sheet Metal Industries,* v. 23, Nov. '46, p. 2159-2164.

Problems discussed include the season cracking of brass, the dezincification of brass, corrosion-fatigue properties of copper-base alloys, resistance of copper to the atmosphere, resistance of copper alloys to sea water, galvanic corrosion in metallic couples and the behavior of copper-nickel alloys. 16 ref. (To be continued.)

6-145. **Galvanic Anodes.** H. A. Robinson. *Metal Industry,* v. 69, Nov. 22, '46, p. 426.

Investigations on the effects on magnesium anode performance, for cathodic protection, of such variables as current density, anode composition, impurities, electrolyte pH and electrolyte composition. (Abstract from paper presented before the Electrochemical Society.)

6-146. **Field Studies and Data on Corrosion Problems in Southeastern New Mexico.** J. I. Laudermilk. *Oil and Gas Journal,* v. 45, Dec. 7, '46, p. 105-106, 108-110.

Types of corrosion and scale deposit encountered and methods used in combating them.

6-147. **Stress-Corrosion of Manganese Bronze Castings in Submarine Service.** Thomas L. Sheehan and Howard E. Dickerman. *Journal of the American Society of Naval Engineers,* v. 58, Nov. '46, p. 586-598.

Such castings have been used extensively for parts subject to high stress and sea water exposure. It was found that manganese bronzes having an alpha-beta microstructure were much less likely to fail because of sea water stress corrosion than those having a complete beta microstructure. Failures of beta bronzes occurred around grain boundaries while failures of alpha-beta bronzes were transcrystalline. Photographs showing microstructure of broken castings are presented. Tabulations and descriptions of test methods and results.

6-148. **Methods of Determining Resistance of Nickel and Nickel Alloys to Corrosion.** *Canadian Metals & Metallurgical Industries,* v. 9, Nov. '46, p. 28-32.

Laboratory methods used in corrosion estimation as outlined by Frank LaQue at the recent corrosion clinic conducted at Toronto University.

6-149. **Some Case Histories of Corrosion Problems in Chemical Process Equipment.** W. Z. Friend and F. L. La Que. *Transactions of American Institute of Chemical Engineers,* v. 42, Oct-Dec. '46, p. 849-860; discussion, p. 861-862.

Histories of investigation of a number of unexpected cases of corrosion of plant equipment illustrate methods of attack sometimes required to solve such problems. These cases include: effect of aeration on reduction of dyestuff; corrosion of nickel tubes in concentration of caustic soda; corrosion of 5% nickel steel tubes in a black liquor evaporator; effect of velocity on corrosion rate of certain oil refinery equipment; and effect of temperature on corrosion of cast iron pipe carrying SO_2.

6-150. **The Corrosion of Elektron AM503 in Contact With Other Metals.** C. J. Bushrod. *Magnesium Review and Abstracts,* v. 6, July '46, p. 67-73.

The corrosion of the British magnesium alloy, AM503, when coupled to stainless steel, cadmium plated mild steel, and anodized duralumin, was investigated under conditions of atmospheric exposure and 3% salt solution exposure. Corrosion-inhibiting effect of various paints and jointing compounds on the above couples was determined.

6-151. **Weathering—Appreciation and a Study.** G. D. Chapman. *Light Metals,* v. 9, Nov. '46, p. 593-597, 607-608.

Significance of atmospheric corrosion of cast light alloys reviewed and illustrated by some experimental work. Possible use of X-rays to determine the type and degree of attack.

6-152. **Corrosion Attack on Chimneys.** J. G. de Voogd and H. J. Tadema. *Gas Times,* v. 49, Nov. 9, '46, p. 134.

Several series of tests were made to determine the effect of waste combustion gases on metals. Details of experiences with nonmetallic materials for waste gas duct construction. (Abstracted from *Brennstoff u. Warmewirtschaft,* v. 23, 1941, p. 189.)

6-153. **Fundamental Factors in Corrosion Control.** Herbert H. Uhlig. *Chemical and Engineering News,* v. 24, Dec. 10, '46, p. 3154-3158.

Fundamental principles of corrosion and its prevention by cathodic protection, coatings, inhibiters and passivaters,

alteration of the environment, metal purification, and alloying. 29 ref.

6-154 **Investigation of Oxidation of Copper by Use of Radioactive Cu Tracer** J. Bardeen, W. H. Brattain, and W. Shockley. *Journal of Chemical Physics,* v. 14, Dec. '46, p. 714-721.

A very thin layer of radioactive copper was electrolytically deposited on a copper blank. The surface was then oxidized in air at 1000° C. for 18 min., giving an oxide layer with a thickness of 1.25×10^{-2} cm. After quenching, successive layers of the oxide were removed chemically, and the copper activity in each layer was measured. Results give a fairly direct confirmation of the theory of oxidation first suggested by Wagner.

6-155. **Defeat of Metal's Enemy Corrosion.** A. M. Low. *Products Finishing,* v. 11, Dec. '46, p. 76, 78, 80.

Brief account of British experience in combating corrosion caused by atmosphere, sea water and sea air, and other corrosives than air and water, in connection with chemical manufacturing and process industrial equipment.

6-156. **The Influence of Movement on the Corrosion of Metals in Salt Solutions and Natural Waters. Part I. Low-Speed Rotation of Mild Steel: Peripheral Velocities Below 100 Ft./Min.** F. Wormwell. *Iron and Steel Institute Advance Copy,* 1946, 10 p.

Using rotating-specimen technique, measurements of oxygen absorption, hydrogen evolution, loss of weight of metal, and depth of penetration of corrosion into the metal have been made with mild steel in 0.5*N* sodium chloride, "conductivity" water, a hard supply water, and sea water. Factors influencing the distribution of corrosion are discussed. 24 ref.

SECTION VII

CLEANING AND FINISHING

7-1. **Processing and Fabrication of Stainless Steel Sheet and Plate Products, III.** H. S. Schaufus and I. C. Clingan. *Steel Processing,* v. 31, Dec. '45, pp. 770-773, 776.

Descaling of chromium-nickel materials. Types of scales; scale removal; production descaling procedures; descaled surfaces; equipment and process control.

7-2. **Wire Galvanizing—Herman Process.** Rowland Hussey. *Wire & Wire Products,* v. 20, Dec. '45, pp. 927-931.

Description of a comparatively new way of applying zinc to carbon steel wire, through a hot dip method called Herman process.

7-3. **The Anodic Treatment of Magnesium Die Castings.** F. A. Root. *Die Casting,* v. 3, Dec. '45, pp. 64-66, 68.

New method of protective treatment for magnesium alloys evaluated and compared with the hydrofluoric acid dichromate chemical treatment. Comparison of corrosion protection afforded, color and thickness of coatings, hardness.

7-4. **Finishing Clinic.** Allen G. Gray. *Products Finishing,* v. 10, Dec. '45, pp. 76-78, 80, 82, 84, 86, 88.

Digest on current technical progress indicating significant trends and developments in finishing industry. Metal cleaners—finishing improperly cleaned metal is costly; rust preventives for all types of service; plastic coatings—new materials, methods, and processes; properties of anodic coatings on aluminum; a new coating thickness gage—magnetic principle, non-destructive.

7-5. **What's Ahead in Product Finishes.** Burr Price. *Products Finishing,* v. 10, Dec. '45, pp. 90, 92, 94, 96.

Abstracts of proceedings of National Paint, Varnish and Lacquer Association. Rapid product finishes; infrared drying; induction heating; coatings for container interiors; prevention of corrosion; metal finishes for aircraft.

7-6. **Electropolishing of Metals.** Charles L. Faust. *Industrial Aviation,* v. 3, Dec. '45, pp. 20, 59-61.

Processes which include such solutions as mixtures of perchloric and acetic acids, sulphuric and citric acids, phosphoric acids and certain alcohols, phosphoric acid and glycerine, sulphuric and hydrofluoric acids, and sulphuric and phosphoric acids.

7-7. **The Sodium Hydride Descaling Process.** Harvey N. Gilbert. *Metal Finishing,* v. 43, Dec. '45, pp. 492-495, 533.

Laboratory development; operation of process; source of sodium hydride; typical installation; operating procedure; advantages of process.

7-8. **Cleaning Before Packaging.** George Black. *Metal Finishing,* v. 43, Dec. '45, p. 496.

Choice of the cleaning method to be used depends upon composition of part, nature of surface, complexity of construction, nature of contaminants to be removed, degree of cleanliness required and availability of cleaning materials and equipment.

7-9. **Anodizing Aluminum.** George B. Hogaboom. *Metal Finishing,* v. 43, Dec. '45, pp. 500-503.

Patent history and digest.

7-10. **Burrs Blasted by Shell.** William L. Lewis. *American Machinist,* v. 89, Dec. 20, '45, pp. 104-105.

Deburr precise and fragile hydraulic parts for aircraft at top speed and without damage using an abrasive made of powdered walnut shells.

7-11. **Conveyorized Painting and Infra-Red Drying Setup.** *Industrial Finishing,* v. 22, Dec. '45, pp. 26-28, 30.

How a completely coordinated system of specially designed infra-red ovens and conveyors stepped up efficiency in mass production painting.

7-12. **Degreasing Die Castings.** Arthur P. Schulze. *Industrial Finishing,* v. 22, Dec. '45, pp. 32, 34, 36-38, 40, 42, 44.

Review of techniques.

7-13. **Electrolytic Polishing.** P. Jacquet. *Metal Industry,* v. 67, Dec. 7, '45, pp. 377-378.

Summary of present position of electrolytic polishing. 50 ref.

7-14. **Electrostatic Paint Spraying at Timken-Detroit Axle Co.** P. D. Aird. *Modern Industrial Press,* v. 7, Dec. '45, pp. 13-14, 46.

Operation similar in application to electroplating where particles of plating solution are deposited on the part to be plated through the operation of electrolysis. In the case of axle operation, voltages used to create electrical field are much higher than those employed in the case of electroplating, where current sufficient to deposit the particles on the opposite pole is all that is required.

7-15. **Use of Solvents in Cleaning Machinery for Reconversion.** Mable Foy. *Machinery,* v. 52, Dec. '45, pp. 165-167.

Deals with the safe use of solvents for removing protective oils and greases.

7-16. **Automatic Multiple-Dip Pickling.** John E. Hyler. *Tool Engineer,* v. 15, Dec. '45, pp. 38-39.

Timed immersion and automatic dip and lift, tank to tank, insure correct interval in each solution.

7-17. **Surface-Conversion Coatings.** George W. Jernstedt. *A.S.T.M. Bulletin,* no. 137, Dec. '45, pp. 29-35.

Base metals involved, basic conversion coating, type of solution, characteristics including appearance and thick-

ness, corrosion resistance, production processes, and variations in finishing.

7-18. **The Technique of Sheet Galvanizing by the Hot Dip Process.** Harold Edwards. *Sheet Metal Industries,* v. 22, Dec. '45, pp. 2096-2103, 2108.

Non-metallic inclusions; macrostructure; surface structure; influence of galvanizing conditions; flux; influence of heating, cooling, roller leveling and cold rolling; modern tendencies and possibilities. 16 ref.

7-19. **Painted Steel.** Ernest S. Hedges and L. A. Jordan. *Iron and Steel,* v. 18, Nov. 30, '45, pp. 591-594.

Use of a tin undercoat to improve the corrosion resistance.

7-20. **Metal Finishing, Part VIII.** H. Silman. *Sheet Metal Industries,* v. 22, Dec. '45, pp. 2155-2156.

Paints, varnishes, and enamels; their formulation and application. 2 ref.

7-21. **Spray Painting.** Robert Steele. *Automobile Engineer,* v. 35, Dec. '45, p. 536.

Bibliography of articles appertaining to automobiles, 1938-1944.

7-22. **Tin Undercoat for Painted Steel.** Ernest S. Hedges and L. A. Jordan. *Engineering,* v. 160, Dec. 14, '45, pp. 505-508.

Use of plated tin undercoatings for increasing corrosion resistance of painted steel surfaces. Accelerated weathering tests showed that surfaces which had been tin-plated had less rust. Data given. (Paper for Iron & Steel Institute.)

7-23. **Lead Coatings.** F. R. Morral. *Products Finishing,* v. 10, Jan. '46, pp. 40-42.

Various processes are used for coating with lead, listed as follows: Hot dipping; electroplating; spraying; fusion; vaporization. 40 ref.

7-24. **Revolving Work for Spraying.** John E. Hyler. *Products Finishing,* v. 10, Jan. '46, pp. 88-90, 92.

Bench-type turntables ideal for revolving small objects; different models discussed.

7-25. **Chromate Passivation of Zinc.** S. G. Clarke and J. F. Andrew. *Metal Industry,* v. 68, Jan. 4, '46, pp. 8-10.

Covers the effect of solution composition, time of immersion, etc., on the films produced and their characteristics, in particular the protective value under humid corrosion conditions. 4 ref.

7-26. **Reconditioning Storage-Tank Surfaces.** Verne M. Coulson. *Oil & Gas Journal,* v. 44, Jan. 5, '46, pp. 80-81, 84.

Methods used in cleaning and priming metal surfaces, employing cold solutions. Much less costly than sandblasting and without that method's attendant hazards, chemical process for removing paint, rust, and scale provides simplicity in operation with minimum equipment.

7-27. **Technical Developments of 1945.** Nathaniel Hall and G. B. Hogaboom. *Metal Finishing,* v. 44, Jan. '46, p. 2-7, 30-31.

Anodizing; corrosion prevention; polishing; cleaning and degreasing; abrasive cleaning; pickling; coatings; metallizing non-conductors; testing and control. 255 ref.

7-28. **Modern Acid Tank Construction.** Richard Neuhaus. *Enamelist,* v. 23, Jan. '46, p. 10-12.

Tank adaptable to all commercial acids, irrespective of temperature and concentration. Construction; selection of materials; membrane; acid brick; cements.

7-29. **Nickel Dipping.** G. H. McIntyre. *Enamelist,* v. 23, Jan. '46, p. 13-20.

Stresses the importance of control of acidity, the permissible ranges of the pertinent variables in operation and the general effects of nickel treatment in relation to blue ground coat and particularly for application of white direct to steel. (Presented before Porcelain Enamel Institute, Inc.)

7-30. **Books and References for the Porcelain Enameler.** Mary Frances Pinches. *Enamelist,* v. 23, Jan. '46, p. 27-31.

Textbooks; bulletins and documents; dictionaries; handbooks; bibliographies; directories; magazines; laboratories; schools and colleges; trade associations.

7-31. **Recent Advances in Porcelain Enameling.** *Steel,* v. 118, Jan. 21, '46, p. 98, 100.

Improvements include zirconium and one-coat enamels for sheet steel; better protective and decorative coatings for cast iron and aluminum; and shorter processing time.

7-32. **Chromate Sealing of Anodic Films.** *Light Metals,* v. 9, Jan. '46, p. 22-35.

"Mechanism of the Chromate Sealing Treatment of Anodic Films on Aluminum", by Tomashov (from *Bulletin of the Academy of Sciences U.S.S.R., Chemical Science Section,* no. 5, 1944). "Development of an Accelerated Chromate Sealing Method for Anodic Films on Aluminum Alloys", by Tyukina (from *Zhurnal Prikladnoy Khimii,* v. 18, no. 3, '45, p. 149).

7-33. **Coatings and Finishes.** Kenneth Rose. *Materials and Methods,* v. 23, Jan. '46, p. 105-108.

Electrodeposited plastics; solder coatings; varicolor plating; thin vitreous coatings.

7-34. **Cleaning and Finishing.** T. C. Du Mond. *Materials and Methods,* v. 23, Jan. '46, p. 140-144.

Cleaning; plating; organic finishing; other finishing methods.

7-35. **Synthetic Detergent Additions in Cleaning Baths.** *Iron Age,* v. 157, Jan. 31, '46, p. 55.

Small percentages of synthetic organic detergents speed up alkaline and acid pickling operations and extend the life of metal cleaning baths. Gaging amount of residual oil by the more exact fluorescent type test indicates that the boosting effect exerted on the cleaning solution is considerable.

7-36. **"Plastipitch"—Protected Metal.** *Railway Age,* v. 120, Jan. 26, '46, p. 231.

New compound which can be used on flat, corrugated or V-crimped sheet metal for roofing, siding, gutters,

ventilators, flashings and ducts. Designed to protect metal against highly corrosive atmospheres, it is said to be particularly effective against smoke-laden atmosphere.

7-37. **Aluminum Pigments—Effect of Particle Size on Durability.** Robert I. Wray. *American Paint Journal,* v. 30, Jan. 28, '46, p. 28-32.

Aluminum paint made with powder is largely intended for decorative purposes. Where it is to be used in paints designed for protection, it is obvious that somewhat higher concentrations than those formerly considered necessary should be employed.

7-38. **Dielectric Heating Speeds Production of Transformer Bushings.** *Industrial Heating,* v. 13, Jan. '46, p. 46, 48.

Has reduced drying time of high-voltage condenser-type transformer bushings by 8 to 10 hr. In this application of high frequency heating, the last trace of moisture in the bushing is driven off by heat generated directly within the insulation. Time formerly lost in bringing bushing up to drying temperature has been saved as the entire insulation reaches the proper temperature within a short time after the power is turned on.

7-39. **Cleaning and Finishing M-69 Bomb Casings, Part II, Copper Brazing of Incendiary Bombs at Republic Steel Corp. Plant.** *Industrial Heating,* v. 13, Jan. '46, p. 125-126.

Description of equipment and operations for final finishing of the bodies.

7-40. **Magnesium Melting Pots Maintained by Metal Spraying.** *Steel,* v. 118, Feb. 4, '46, p. 130, 132, 173-174.

Process inhibiting scale formation on pot surfaces affords longer pot life and reduces explosion hazard.

7-41. **Sodium Hydride Descaling.** W. B. Billingsley. *Canadian Metals and Metallurgical Industries,* v. 9, Jan. '46, p. 19-24.

Advantages of the process; laboratory development of the process; large scale installations; description of a typical installation.

7-42. **Infra-Red Versus Convection Heating.** Charles C. Eeles. *Western Metals,* v. 4, Jan. '46, p. 23-28.

Theory and practice of industrial finish curing; stresses fact that future convection oven design will be able to attain equal or greater speeds than infra-red curing without its handicaps; provides industrial gas engineers with information which will serve as a yardstick in measuring the qualifications of various oven proposals their customers may entertain for modern finish curing equipment.

7-43. **The Welding of Glass to Metal.** E. M. S. Wood. *Glass Industry,* v. 27, Jan. '46, p. 24, 46, 51.

Process consists in using the "Schoop" metal-spraying pistol or gun to spray finely divided fused metal onto the glass, which must be pre-heated to obtain adhesion. Only metals with which the process is readily effective are aluminum or alloys of aluminum with small amounts of manganese; with these metals adhesion is secured if glass is at a temperature of about 300° C. when sprayed.

Subsequently other metals such as copper can be sprayed onto the aluminum if it is necessary to provide a metal surface which will take solder.

7-44. **Suggested Layout for a Continuous Furnace Enameling Plant for Reflectors.** M. M. Murphy. *Finish,* v. 3, Feb. '46, p. 31-34.

Layout designed to include all essential details for an up-to-date, conveyorized, high production plant.

7-45. **Metal Coating by Vacuum Evaporation.** F. C. Benner. *Modern Plastics,* v. 23, Feb. '46, p. 110-111.

A simple and quick method of plating plastics with gold, silver, aluminum, chromium, nickel, tin and even platinum. Finish of the metal coating depends upon the finish of the plastic to which it is applied. Process and advantages of method.

7-46. **Flame Spraying.** W. D. Jones. *Metal Industry,* v. 68, Jan. 25, '46, p. 63-65.

Corrosion protection by application of powdered materials.

7-47. **Mixed Acid Pickling and Recovery Installation Based on the De Lattre Process.** Edward W. Mulcahy. *Sheet Metal Industries,* v. 23, Jan. '46, p. 77-81.

Process; pickling plant; crystallizing; cooling curve illustration; crystallizer structure.

7-48. **Surface Treatment of Hot-Dip Galvanized Coatings Preparatory to Painting and Its Relation to Corrosion Resistance.** E. F. Pellowe and F. F. Pollak. *Sheet Metal Industries,* v. 23, Jan. '46, p. 82-83.

Protective action of galvanized coating; painting galvanized steel; methods of promoting paint adhesion.

7-49. **Treatment of Spent Pickling Liquors.** *Steel,* v. 118, Feb. 11, '46, p. 104, 106, 108, 154.

Substantial economy can be realized by using high calcium limestone to neutralize free acid and precipitate part of the iron, and by use of lime to complete treatment. 2 ref.

7-50. **A Review of Product Finishing With Organic Coatings. Part IV.** *The Enamelist,* v. 23, Feb. '46, p. 42-44, 46-50.

Accelerated testing of organic coatings.

7-51. **Conveyorized Enameling of Castings.** Herbert Chase. *Iron Age,* v. 157, Feb. 14, '46, p. 53-55.

Cast and stamped components to be cleaned, bonderized, sprayed and baked are handled by a continuous chain conveyor, which in combination with specially designed controls permits flexibility of functions and holds rejects to the neighborhood of 0.5%.

7-52. **Rapid Product Finishes.** Paul O. Blackmore. *Paint and Varnish Production Manager,* v. 25, Dec. '45, p. 311-312, 314.

Drying primarily by polymerization; drying time of 9 sec. reported; infra-red drying, induction heating, and freezing methods.

7-53. **Special Maintenance Finishes for Specific Problems.** W. F. Kuster. *Paint and Varnish Production Manager,* v. 26, Jan. '46, p. 10-13.

Rusting and rust prevention described. Red lead and oil primers versus red lead and synthetic resin vehicles for quick dry, greater water resistance, and abrasion resistance. Paints for tankers, petroleum reservoirs, filter tanks, dams, spillways; use of zinc dust coatings.

7-54. **Parts Salvaged by Metallizing, Part I.** Walter J. Brooking. *Welding Engineer,* v. 31, Feb. '46, p. 40-43.

How metallizing can salvage worn or mismachined parts.

7-55. **Coating, Lithographing and Fabricating Aluminum.** G. L. McClain. *Modern Lithography,* v. 14, Jan. '46, p. 28-29, 77, 79.

Properties of aluminum as found in production of caps and closures and in decorating and forming wartime cans.

7-56. **Infra-Red Drying.** F. L. Atkin. *Industrial Gas,* v. 24, Feb. '46, p. 13-15, 31-34, 36, 38.

Some experiments and results with gas-fired equipment on high speed baking of paint finishes and other drying processes using radiant heat.

7-57. **Lockheed Aircraft Finds Many Uses for Metallizing.** *Steel,* v. 118, Feb. 25, '46, p. 113-114, 138.

Master patterns for profiling machines, metal shells to hold work for drilling and trimming, welding machine and other machinery parts all built up by metal spraying.

7-58. **Automatic Spraying in the Porcelain Enamel Industry.** L. W. Lammiman. *Better Enameling,* v. 17, Feb. '46, p. 11-14.

Brief description given of rotary turntable, chain conveyor, cylinder coating, automatic spraying machine. Transverse moving gun type covered in greater detail.

7-59. **Synthetics in Industrial Finishing.** Gilbert C. Close. *Industrial Finishing,* v. 22, Feb. '46, p. 26-28, 30, 32, 34, 36, 38, 40.

Certain types of synthetic materials and what special merits and characteristics they impart to protective and decorative coatings for all new products.

7-60. **Three Examples of Modern Practice in the Recovery of Waste Pickling Liquors.** Paul De Lattre. *Sheet Metal Industries,* v. 23, Feb. '46, p. 282-286, 288.

Short description of three separate plants which have been in regular operation for more than eight years. In the first instance, pickling is effected before galvanizing the tube. In the second, tubes are pickled preparatory to cold drawing, after annealing, etc. In the third plant, method used is the continuous pickling and regeneration process.

7-61. **The Decoration of Black Plate and Tin-Plate.** T. A. Miller. *Sheet Metal Industries,* v. 23, Feb. '46, p. 291-292, 298.

Recent developments and future possibilities.

7-62. **The Chemistry and Mechanism of Steel Pickling.** Brian N. Reavell. *Sheet Metal Industries,* v. 23, Feb. '46, p. 323-326.

General consideration of the chemistry and mechanism of steel pickling employing phosphoric, hydrofluoric, mixtures of nitric, hydrochloric and chromic acids.

7-63. **Surface Condition of Metals.** *Sheet Metal Industries,* v. 23, Feb. '46, p. 338-344.

Electronic methods; electrochemical methods; electron microscope; surface physical chemistry; anodic oxidation; electrolytic polishing; developments in Britain; microgeometry of surfaces; surface measurement; influence of surface finish on properties. (Abstracts from papers presented at the "Journees d'Etudes sur les Etats des Surfaces Metalliques" held in Paris in October.)

7-64. **Use of Infra-Red in Metal Processing.** Paul H. Krupp. *Steel Processing,* v. 32, Feb. '46, p. 119-121.

Infra-red has made major contribution in the field of baking protective coatings on metal. Method affords speed-ups ranging from 50% to 200% or more. In innumerable cases the quality of the finish is far superior when baked with radiant energy.

7-65. **Stripping Metallic Coatings.** *Materials and Methods,* v. 23, Feb. '46, p. 477.

Table gives coating; basis metal; solution; remarks.

7-66. **Vitreous Enamels on Aluminum.** B. C. Bricker. *Better Enameling,* v. 17, March '46, p. 10-11.

Preparation of metal; application; firing.

7-67. **Rebuilt Turbine Housing.** *Steel,* v. 118, March 11, '46, p. 108, 142.

Restoration of eroded surfaces by rebuilding with sprayed metal keeps irreplaceable unit in service.

7-68. **Spray-Finishing and Drying Aluminum Fabrications at Woodall Industries.** *Industrial Heating,* v. 13, Feb. '46, p. 301-308.

Painting and finishing equipment; paint-drying oven; dipping and drying line.

7-69. **Metal Surface Preparation for Black Oxide Finishing.** Arthur P. Shulze. *Metal Finishing,* v. 44, March '46, p. 102-105.

Iron and steel; copper; brass and bronze; aluminum; zinc; chromated parts.

7-70. **Infra-Red Speeds Bumper Production on New Automobiles.** *Products Finishing,* v. 10, March '46, p. 50-52.

Bumper frames finished with black baked-out paint at the rate of 300 per hour. Volume is achieved by an infra-red oven only 21 ft. long. Oven has three special features which not only provide for unusual heat densities but also direct penetration of the infra-red rays to the painted surface.

7-71. **Finishing Clinic.** *Products Finishing,* v. 10, March '45, p. 54-55, 58, 60, 62, 64, 66, 68.

Choosing a finish for magnesium; the role of nickel flashing in enamel adherence; electrolytic analysis of strike solutions suitable for production use; fungicide coatings; black anodizing copper and brass; proper pretreatment of metals essential for quality finish.

7-72. **Styling With Plated Finishes.** *Die Casting,* v. 4, March '46, p. 58-60, 62, 65-66.

Tumbling, polishing and degreasing, burnishing, and plating of die-cast belt buckles.

7-73. **The Formation of Dross in Hot-Dip Galvanizing.** Phillip M. Fisk and F. F. Pollak. *Sheet Metal Industries,* v. 23, March '46, p. 490-492, 494.

An investigation of the effect of the pickling operation.

7-74. **A Protective Finish for Magnesium Alloys.** R. B. Mason. *Iron Age,* v. 157, March 21, '46, p. 48-52.

Protective finish which provides a heavy oxide coating with high abrasion and corrosion resistance. Finish is produced by anodic oxidation of the magnesium alloy in a sodium hydroxide electrolyte followed by sealing in a chromate solution. 6 ref.

7-75. **Nonferrous Metals Aid in Steel's Use.** Jacob Levin. *Journal of Chemical Education,* v. 23, March '46 p. 142-144.

Application of various nonferrous metals to steel, especially tin and zinc.

7-76. **Covering Wire With Glass.** *Wire Industry,* v. 13, March '46, p. 151-152.

Describes and illustrates a machine for glass insulation wire covering with an electric heated varnish baking oven as one combined equipment unit.

7-77. **A New West Coast Plant Designed for Straight Line Production.** Gilbert C. Close. *Finish,* v. 3, March '46, p. 13-16, 48.

Norris Stamping plant includes "world's largest" continuous furnace, 12-tank pickle room, overhead dryers and 2/5 mile of conveyer chain.

7-78. **Putting a Glassy, Smooth Finish on the Shooting Star.** Fred M. Burt. *Industrial Finishing,* v. 22, March '46, p. 27-32.

New materials and technique used to condition all metal surfaces. Gives 11 important steps in superfinishing schedule.

7-79. **Our Planned Setup for Painting Machine Parts.** C. Raymond Syer. *Industrial Finishing,* v. 22, March '46, p. 36-42, 44, 46, 48, 50.

New methods and equipment eliminate rust and do away with brushing methods as far as practicable; modern methods adopted for cleaning, spraying, dipping and baking in order to get a more desirable and durable finish at a lower cost of production.

7-80. **Finishing Detachable Buttons.** Arthur A. Oertel. *Industrial Finishing,* v. 22, March '46, p. 60, 62, 64, 66.

Process includes dry-cleaning by tumbling and screening; coating by spray-tumbling and force-drying in a gas-fired conveyerized oven.

7-81. **Protective and Decorative Treatments of Magnesium.** L. M. Oldt. *Light Metal Age,* v. 4, March '46, p. 10-13.

Cleaning methods; decorative treatments; protective chemical treatments; painting.

7-82. **Preparing Aluminum for Finishing.** Arthur P. Schulze. *Light Metal Age,* v. 4, March '46, p. 14-17.

Merits of various modern methods of cleaning and preparing aluminum surfaces for finishing operations. Sandblasting; solvent degreasing; vapor degreasing; alkaline

cleaning; precleaning procedures; mechanical washing machines; alkaline etching; acid etching; metallic oxide removal; surface conditioning with dilute acids. 13 ref.

7-83. **Modern Finishing of Light Metals.** Allen C. Gray. *Light Metal Age,* v. 4, March '46, p. 18-20, 22.

Cleaning magnesium; surface preparation for aluminum brazing sheet; assembly protection practice for magnesium; classification of anodizing processes for aluminum.

7-84. **Anodic Oxidation of Aluminum.** W. G. Cass. *Chemical Age,* v. 54, March 9, '46, p. 259-261.

Study of film formation; use of X-ray methods; some Russian work; effect of impurities; reflecting surfaces; use of sulphamic acid; Piontelli's process.

7-85. **Method of Evaluating Metal Cleaners.** Samuel Spring, Howard I. Forman, and Louise F. Peale. *Industrial and Engineering Chemistry, (Analytical Edition),* v. 18, March '46, p. 201-204.

Quantitative method for performance evaluation of alkaline metal cleaners. Method involves coating of metal panels with various oils by a specific dipping and drainage technique, followed by a carefully controlled cleaning and rinsing procedure. The panels are covered with a fine spray of water, which condenses as droplets on the oil-covered areas, providing a pattern that remains constant for a sufficient time for a sketch to be drawn on paper divided into 100 squares. Average value for cleaned area of five panels is the cleaning efficiency index. Conditions influencing results and variations in the procedure are discussed.

7-86. **Chemical Removal of Scale From Fire-Tube Boilers.** C. H. Groom and E. C. Hardy. *Power Plant Engineering,* v. 50, April '45, p. 66-67.

Case studies of results secured by chemically cleansing various types of fire-tube boilers. Recommended procedure to be followed in using chemical descaling method.

7-87. **Surgical Instrument Finishing and Plating.** Joseph G. Cowley and Floyd McKnight. *Metal Finishing,* v. 44, April '46, p. 150-152.

Step-by-step finishing operations at Haslam plant in Glendale, L. I., using as a typical instrument a stainless steel forceps.

7-88. **Metal Coloring.** Martin F. Maher and Franklyn J. MacStoker. *Metal Finishing,* v. 44, April '46, p. 153-154, 163.

Brass plating; coloring of brass; steel bronze; interference colors on brass; verde and patina finishes; brown colors on brass.

7-89. **Metalizing Nonconductors.** Bertram Shomberg. *Metal Finishing,* v. 44, April '46, p. 157-160.

Improving adhesion; general principles; plating on wax; carbon and graphite.

7-90. **Combination of Acids Employed in Pickling Process.** E. W. Mulcahy. *Steel,* v. 118, April 15, '46, p. 122-124.

Hydrochloric acid used in combination with sulphuric acid and inhibitor. Mix is maintained at low constant temperature. Process affords increase in pickling speed,

minimizes acid and steam consumption and loss of iron and has a distinct advantage over straight sulphuric acid baths. System of recovery is simplified.

7-91. **Finishing Clinic.** Allen G. Gray. *Products Finishing,* v. 10, April '46, p. 50-52, 54, 56, 58, 62, 64.

Practical procedure for electroplating on aluminum; applications of bright dipping and some formulas; tin undercoats improve corrosion resistance of painted steels; engineering of infrared heating for drying and baking; measurement of reflectance in the porcelain enameling plant.

7-92. **Using Metal Spraying for Quick Repairs.** Daniel L. Cannie. *Factory Management and Maintenance,* v. 104, April '46, p. 103-104.

Repair of worn or corroded journals and bearing shafts by use of metal spraying process effects substantial savings in equipment maintenance costs. Can be made within scheduled shutdown periods. Downtime on productive machinery either completely avoided or minimized to short delays. Benefits reflected in higher production output and a lower unit cost.

7-93. **Mass Production of Porcelain Enamelware.** Fred M. Burt. *Tool Engineer,* v. 16, April '46, p. 18-24.

Preparation of metal surfaces; enamel, its manufacture and preparation; smelting; milling; all colors and pastel shades attainable; enamel application by dipping, draining and spraying; dipping requires dexterity and experience; brushing; burning.

7-94. **Infrared Ovens Speed Drying.** Phil Glanzer. *Tool Engineer,* v. 16, April '46, p. 25.

From a previous time of several hours, the time for drying the finish hard enough to handle has been reduced to about four minutes.

7-95. **The Balanced-Action Bath and Its Position in Modern Pickling Technique.** Paul De Lattre. *Sheet Metal Industries,* v. 23, April '46, p. 685-694.

Ferrous sulphate evolved during pickling in sulphuric acid solutions has a dangerous influence on the speed of operation, and involves considerable risk of defects in enameling or galvanizing. Addition of hydrochloric acid reduces ferrous sulphate content, producing ferrous chloride and liberating sulphuric acid. This reaction has many advantages, including nullifying the deleterious effect of the ferrous sulphate and making for high speed of reaction of the solution upon iron and its oxides.

7-96. **The Use of Glycerine in Metal Processing.** *Industrial Chemist,* v. 22, March '46, p. 125-127.

Electropolishing, electroplating, electrolytic refining, protective coatings, use of glycerine in the preparation of tinning and soldering pastes.

7-97. **Tin Undercoat.** E. S. Hedges and L. A. Jordan. *Steel,* v. 118, April 22, '46, p. 103, 106, 108, 111.

Greatly improves corrosion resistance of painted steel. Deposition of 0.00003-in. coat of tin from sodium stan-

nate bath, followed by application of antirusting oxide film found best protection system. (Presented to Iron & Steel Institute.)

7-98. **What the Metal Decorator Should Know About Protective Coatings.** M. G. Gardner. *Modern Lithographer,* v. 14, March '46, p. 27-29.

Defines varnish, lacquer and enamel; their properties and application to metal.

7-99. **Food Canning.** *Iron and Steel,* v. 19, April '46, p. 147-148.

Investigations of tin-plate substitutes in Germany, principally phosphating

7-100. **Automatic Mechanical Pickler.** John D. Knox. *Steel,* v. 118, April 29, '46, p. 123-124.

Affords 40 to 60 % savings. Bars brought by crane to pickling tank are deposited on four loops of chain which roll or tumble them so that their entire surface is exposed to the action of the acid. Spreaders in bottom of vat aid in separating the batch of bars.

7-101. **Tested Results on Maintenance of Infrared Equipment.** Ira J. Barber. *Industrial Finishing,* v. 22, April '46, p. 40, 42, 44, 46.

Tests indicate that the presence of dirt and dust on bulbs and reflectors does not cut down their drying efficiency as much as might be assumed.

7-102. **Painting Accessories for Refrigerators. Part I.** John Wright. *Industrial Finishing,* v. 22, April '46, p. 65-68, 70, 72, 74.

Metal cleaning and surface preparation.

7-103. **Corrosion of Metals.** W. G. Cass. *The Chemical Age,* v. 54, April 6, '46, p. 373-374.

New developments in phosphating methods shorten length of time required, extend method to other metals than iron and steel, lower the temperature required and extend the use of phosphating as an aid to lubrication in many metal working operations such as deep drawing and wire manufacture.

7-104. **Rustproof Coating.** *Steel,* v. 118, May 6, '46, p. 155.

New rustproofing technique for steel and galvanized steel which deposits a coating of from 0.000005 to 0.0000015 in. will protect stock during manufacturing stages and permit a tighter bond with paints. Consists of a glassy metal phosphate, so plastic that it will bend with the steel or permit die stamping without harm to the coating.

7-105. **Bright Dipping.** Gustaf Soderberg. *Steel,* v. 118, May 13, '46, p. 109-110.

Process for cadmium, copper and its alloys, magnesium, and zinc can be used to enhance surface appearance, condition the surface for plating, or passivate it to prevent corrosion. (Paper presented at Electrochemical Society symposium.)

7-106. **High Speed Production Metallizing.** L. E. Browne. *Steel,* v. 118, May 13, '46, p. 93, 148, 150.

St. Louis company makes effective use of heavy-duty metal spraying gun on pump plungers and tank interiors. Performance in continuous operations distinguished by greater volume of metal deposited and reduced consumption of gases.

7-107. **Production Metallizing Speeds Aircraft Engine Output.** H. E. Linsley. *Industrial Gas,* v. 24, May '46, p. 11-12.

Through close cooperation between machine manufacturers and the methods engineers of the Wright Aeronautical Corp., a procedure has been worked out for handling the complete operation on a line production basis in less than 8% of the time formerly required.

7-108. **Pickling and Bright Dipping Copper-Zinc Alloys.** George B. Hogaboom. *Metal Finishing,* v. 44, May '46, p. 198-201.

Pickling; scaling dips; bright dips; neutralizing.

7-109. **Electrolytic Cleaning of Zinc and Zinc Alloys in Alkaline Baths.** Fred Hazel and William Stericker. *Monthly Review,* v. 33, April '46, p. 373-388.

Experiments were undertaken to determine whether or not zinc die castings should be cleaned with sodium silicates or even with compounds containing them. Materials and methods; effects on zinc and zinc alloys; recommendations.

7-110. **Handling 50,000 Die Castings a Day.** *Die Casting,* v. 4, May '46, p. 62-65.

Modern, mechanized finishing department applies organic coatings to aluminum, zinc, magnesium, and brass die castings in large quantities. An enclosed 420-ft. conveyer system speeds up production from cleaning to final inspection.

7-111. **Removing Sand and Scale From Gray-Iron Castings.** *Iron Age,* v. 157, May 16, '46, p. 51.

Successful use of the Du Pont sodium hydride descaling process for removing sand and scale from gray-iron oil pump bodies and parts is reported by a large midwestern plant.

7-112. **Choice of Organic Finishes.** P. W. Prouty. *Organic Finishing,* v. 7, May '46, p. 19-21, 24-29.

Composition and properties of finishes; selection of finishes; precleaning; testing; making test samples.

7-113. **Organic Coatings for Magnesium.** Howard E. Smith, James E. Creager, R. Donald Weir, and Joseph Ward. *Organic Finishing,* v. 7, May '46, p. 31-33, 36-40, 45.

Current finishes for magnesium fall into four classifications: wrinkle finishes; gloss finishes; eggshell or semigloss finishes; and flat or lusterless finishes. A few of the general characteristics of these new finishes are noted.

7-114. **Characteristics of Aluminum Finishes.** George Black. *Organic Finishing,* v. 7, May '46, p. 42-43.

Aluminum finishes are fundamentally different from other finishes in film structure. Instead of being granular in shape, the aluminum pigment particles are in the form of minute overlapping flakes, with a thin cement

of vehicle between the horizontal layers thus formed. This phenomenon, known as leafing, accounts for the excellent impermeability of aluminum finishes as well as for many other noted characteristics.

7-115. **Applied Finishes for Zinc Alloy Die Castings.** *Product Engineering,* v. 17, May '46, p. 389-393.

Organic, plastic, electrolytic, and chemical immersion finishes applicable to zinc alloy die castings. Appearance, commercial adaptability and general utility; methods of application, limitations, and practical uses.

7-116. **Finishing at Chicago's Central Scientific Co.** Bryant W. Pocock. *Products Finishing,* v. 10, May '46, p. 30-44.

Nickel plating; black nickel plating; cadmium plating; oxidize finishing; grease wheel finishing; aluminizing; japanning; black rubber finishing; white Dulux finishing; black cloth finishing, nonconducting black finishing.

7-117. **Finishing Clinic.** Allen G. Gray. *Products Finishing,* v. 10, May '46, p. 50-62.

Future possibilities in protective coatings from plastics; porcelain enamels can be sprayed electrostatically; cleaning magnesium; surface finishing of beryllium-copper alloys; a new process for scale removal on stainless steels; thickness determination of terne-plate coatings.

7-118. **Organic Finishes for Zinc Alloy Die Castings.** Burr Price. *Products Finishing,* v. 10, May '46, p. 66-71.

Finishes; cleaning and pretreatments; alkaline cleaning; solvent cleaning; chemical and mechanical pretreatments; baking temperatures.

7-119. **What the Metal Decorator Should Know About Protective Coatings.** M. G. Gardner. *Modern Lithography,* v. 14, May '46, p. 75-79, 121.

Enameled coatings applied by roll-coater machine to the sized or bare metal plate. Film weight or thickness is regulated by adjusting the clearance between the steel pickup and the steel distributing roll.

7-120. **Tinning of Cast Iron.** R. A. Cresswell. *Foundry Trade Journal,* v. 78, April 25, '46, p. 435-439.

Methods for hot tinning cast iron directly (without the application of an intermediate metal coating). Influence of modifications in the successive stages of cleaning, pickling, fluxing, and tinning was first studied. It was found that better tinning was obtained by preparing the cast iron for tinning by treatment in fused salts.

7-121. **Preparing Die Castings for Plating.** Herbert Chase. *Iron Age,* v. 157, May 23, '46, p. 58-61.

Production-line polishing, buffing and tumbling of zinc alloy die castings preparatory to plating in one of the largest die-casting plants in the country. Use of conveyers and fixtures to expedite operations.

7-122. **Mass Production of Cast-Iron Enamelware.** Fred M. Burt. *Tool Engineer,* v. 16, May '46, p. 34-37.

Modern layouts, equipments, procedures and materials employed in efficient production of cast-iron and porcelain-enameled products, such as bathtubs, sinks, and

other sanitary ware; research work to determine what might be employed to build and operate an ideal postwar enamel plant for cast iron.

7-123. **New Pickle Room Features Ventilation.** *Enamelist,* v. 23, May '46, p. 26-29.

Off-the-surface exhaust or ventilation is satisfactory method of keeping a room clear of fumes and steam.

7-124. **Metal Cleaning by Solvent Degreasing.** S. J. Trezac. *Industrial Finishing,* v. 22, May '46, p. 23-28, 112.

Parts cleaning process solves many production problems; chief types, features and uses.

7-125. **Electrostatic Spraying.** Emery P. Miller. *Industrial Finishing,* v. 22, May '46, p. 30, 32, 34, 36, 41-42.

What electrostatic spraying is; how it differs from a regular automatic spray-painting setup; what happens when paint is sprayed in an electrostatic field; what kinds and products to be painted will work effectively in this kind of setup; what the merits of electrostatic spraying are in production painting.

7-126. **Chemical Black and Color Finishes for Metal.** Arthur P. Schulze. *Industrial Finishing,* v. 22, May '46, p. 44, 46, 48, 50, 52, 54, 56.

Durable corrosion resistant black finishes for bright, clean iron, steel, zinc and cadmium surfaces; black and color finishes for copper and brass alloys; all produced by immersion in hot solutions of chemicals. Will serve as final finishes in glossy or matte luster, or as good undercoats for paints, varnishes, lacquers or synthetics.

7-127. **Continuous Production—Metal Cleaning; Dip Coating; Baking.** Gilbert C. Close. *Industrial Finishing,* v. 22, May '46, p. 60-63.

Analysis of a war production setup reveals many features that can be adapted profitably for cleaning and protectively coating peacetime products.

7-128. **What's Wrong in Some Finishing Rooms.** C. Raymond Syer. *Industrial Finishing,* v. 22, May '46, p. 66, 68, 70.

Cleanliness needed in every paint department; check the air pressure; strain paint materials; fire prevention is fire protection; agitate or stir or mix your finishing materials; some common troubles and what causes them.

7-129. **Costly Tools and Metal Components Protected by Plastics Coatings.** F. L. Gerin. *Tool & Die Journal,* v. 12, May '46, p. 93-95.

Application of ethylcellulose is simple and relatively inexpensive. Coating is tough and resistant.

7-130. **Sodium Hydride Descaling and Desanding of Ferrous Castings and Forgings.** *Industrial Heating,* v. 13, May '46, p. 796-802.

Setup described by this manufacturer is quite simple. Utilizes the Ajax-Hultgren salt bath furnace (immersed-electrode heating principle). Gives entire operation.

7-131. **Nickel Dipping.** G. H. McIntyre. *Foundry Trade Journal,* v. 79, May 2, '46, p. 9-11.

Review of the literature; variables to be controlled; time, temperature and pH; experimental results; removal

of iron salt deposits from steel; recommended pickle room procedures; recommended sequence for nickel flash. (Presented at the seventh annual forum of the Porcelain Enamel Institute.) 7 ref.

7-132. **Terne-Coated Sheet—Calculations for Manufacturers and Users.** J. H. Mort. *Iron and Steel,* v. 19, May '46, p. 189-191.

Determination of specific gravity; conversion of coating weight from lb. per base box to oz. per sq. ft.; calculating proportion of terne alloy in a given weight of finished terne-plate; weight and thickness of coating expressed in various terms; determining difference in cost in substituting terne for tin.

7-133. **Sodium Hydride Descaling.** Edwin Laird Cady. *Materials & Methods,* v. 23, May '46, p. 1278-1283.

Experience in stainless and alloy steel mills points to the use of this new process for many descaling, deoxidizing, and skin softening tasks. Twelve large-scale installations of the process are in operation; installation at Carpenter Steel Co. described.

7-134. **The Balanced Action Bath and Its Position in Modern Pickling Technique.** Paul De Lattre. *Sheet Metal Industries,* v. 23, May '46, p. 899-901.

Application of the "balanced action bath" technique to pickling and the recovery of spent liquors. Selecting proper concentration of hydrochloric acid to get the best pickling efficiency and an efficient regeneration cycle. Properties of the balanced action bath are far from those that could be expected from an averaging of the properties of ordinary hydrochloric and sulphuric acid solutions. 13 ref.

7-135. **Metal Finishing. Part VIII.** H. Silman. *Sheet Metal Industries,* v. 23, May '46, p. 949-953, 956.

Paints, varnishes, and enamels—their formulation and application.

7-136. **Rustproofing Process Proves Advantageous to Fabricators.** Gilbert P. Muir. *Steel Processing,* v. 8, May '46, p. 298-300.

Banox process consists of the application of a thin coating of amorphous phosphate to steel before painting and as a protective undercoat for further organic finishes. It is adequate as a temporary finish for periods ranging up to several months under dry storage conditions.

7-137. **Cast Iron. Quality of Hot-Dipped Tin Coatings.** R. A. Cresswell. *Iron and Steel,* v. 19, May 10, '46, p. 258-263.

Outlines research to evolve methods for hot-tinning cast iron directly, i.e., without the application of an intermediate metal coating. Influence of modifications in the successive stages of cleaning, pickling, fluxing, and tinning first studied. Found later that better tinning is obtained by departing from the above sequence and preparing the cast iron for tinning by treatment in fused salts.

7-138. **The Evaluation of Surface-Active Agents.** Jay C. Harris. *ASTM Bulletin,* no. 140, May '46, p. 76-83.

Evaluation tests described are: acid stability; alkali

stability; caustic soda solubility; metallic ion stability; surface and interfacial tension values and spreading coefficient; lime soap dispersion; Draves-Clarkson wetting test; canvas disk wetting test; lather value; organic solvent solubility, and detergent test.

7-139. **Chemical Conversion Coatings.** G. W. Jernstedt. *Metal Industry,* v. 68, May 24, '46, p. 407-409.

Surface conversion coatings on copper and brass, aluminum, magnesium, zinc and cadmium. Existing procedures for producing the coatings and characteristics of the coatings formed. Tendency today is toward the development of finer-grained, more flexible finishes so that the coated metals may be formed to the finished part.

7-140. **Small Parts Plating.** William Ehrencrona. *Die Casting,* v. 4, June '46, p. 60, 62, 64, 66.

Well-integrated continuous line operation utilizing automatic equipment speeds up plating on automobile accessory parts.

7-141. **Buffing Small Parts.** H. Moore. *Metal Finishing,* v. 44, June '46, p. 247, 253.

Methods of holding small parts so that such things as nuts, washers, screw heads, pins and hooks will be completely and carefully polished and finished.

7-142. **Coated Abrasives Solve Many Reconversion Metal-Finishing Problems.** *Machinery,* v. 52, June '46, p. 174-175.

Through use of rotating tools that utilize war-born coated abrasives appreciable saving in time has resulted on various jobs. Example given of finishing walls and corners of small holes in metal parts.

7-143. **Controlling Hydrofluoric-Nitric Pickling Baths.** *Steel,* v. 118, June 10, '46, p. 110-112.

Testing has been expedited by rapid methods of analysis, reducing need for bath replacement and saving much time.

7-144. **Maintain, Reclaim, Protect With Metal Spraying Process.** W. C. Reid. *Industry and Power,* v. 50, June '46, p. 76-77.

Metallizing or metal spraying methods make repairs, conserve materials, salvage parts, increase life of shafting and bearings, and provide corrosion resistant surfaces.

7-145. **Finish Durability Improved With Vitreous Phosphate Coating.** C. T. Roland and H. I. Rosenbloom. *Steel,* v. 118, June 17, '46, p. 122, 124, 126, 129.

Cold, aqueous solutions spontaneously coat steel and zinc with amorphous film sufficiently plastic to withstand forming and drawing operations.

7-146. **Electropolishing Metals to Obtain Surface Finish.** Charles L. Faust. *Product Engineering,* v. 17, June '46, p. 449-451.

Recent applications, advantages and limitations of the process. Diverse uses of the process; types of surface finishes for metals compared; design data and information; cost of typical processing equipment and relative costs of finished products.

7-147. **Electrostatic Detearing.** Emery P. Miller. *Industrial Finishing,* v. 22, June '46, p. 31-36.

In this process, the items being dipped or flow-coated are usually supported from an electrically grounded conveyer. The coated articles pass over or adjacent to an insulated conducting grid which is charged with high-voltage static electricity. The presence of this charged grid causes an attractive electrical force to be exerted upon the grounded piece within the active field of static electricity. Due to this attraction, the excess paint, enamel or liquid plastic will be removed from the piece, leaving a smoothly coated surface.

7-148. **Electrostatic Coating Processes.** Arthur P. Schulze. *Organic Finishing,* v. 7, June '46, p. 9-20, 26.

Electrostatic detearing and spraying.

7-149. **Static Saves Sprayed Paint.** Emery P. Miller. *American Machinist,* v. 90, June 20, '46, p. 141-144.

Atomized particles of sprayed coating, attracted to the work in an electrostatic field, give more uniform coverage and reduce overspray and loss, particularly on odd-shaped small pieces.

7-150. **A Review of Inhibitors. Part I—Section A.** Wallace G. Imhoff. *Wire and Wire Products,* v. 21, June '46, p. 447-450, 478-483.

The author's object in presenting this review is first to summarize all the work done by others on this subject and second to attempt to explain clearly what takes place when inhibitors are used in acid pickling baths.

7-151. **Roto-Finish Process.** A. H. Allen. *Steel,* v. 118, June 24, '46, p. 99-104.

Smooth, bright finishes are imparted to parts made of various metals, and edges are deburred by using limestone or granite chips, honing compounds and steel balls in this tumbling barrel process.

7-152. **Finishing at United Platers, Inc. of Detroit.** Bryant W. Pocock. *Products Finishing,* v. 10, June '46, p. 46-48.

Plant and equipment.

7-153. **Finishing Clinic.** Allen G. Gray. *Products Finishing,* v. 10, June '46, p. 80-82, 84, 86, 88, 90, 92.

Accelerated testing of organic coatings; reducing losses in chromium plating baths; new protective finish for magnesium alloys; dross formation in hot-dip galvanizing operations; plastics can be plated; heat resistant paints.

7-154. **Anodizing and Coloring Aluminum.** *Canadian Metals & Metallurgical Industries,* v. 9, June '46, p. 34-36.

By electrolytic deposit of an oxide film on aluminum, Canadian Anodized Products, Limited, produces brilliant finishes combined with better corrosion resistance by the anodizing process.

7-155. **Tinning of Cast Iron.** R. A. Cresswell. *Canadian Metals & Metallurgical Industries,* v. 9, June '46, p. 37-41, 44.

Nitrate process is preferred for tinning cast iron by dipping, and the chloride process for tinning by wiping, but the chloride process is satisfactory for dip tinning when the castings are sound and well cleaned mechani-

cally. Either process can be used satisfactorily for coating cast iron with tin-lead alloys by hot dipping. (Paper presented before the Iron and Steel Institute, 1945.)

7-156. **The Tinning of Cast Iron.** R. A. Cresswell. *Engineering,* v. 161, May 31, '46, p. 526-528.

The object of the research was to evolve methods for hot tinning cast iron directly, that is, without the application of an intermediate metal coating. (Paper for the Iron and Steel Institute.)

7-157. **Blast Cleaning Materials, Methods, and Equipment.** Francis L. Pettingil. *Organic Finishing,* v. 7, June '46, p. 33-39.

A review of compressed air blasting equipment on the market today.

7-158. **Uses of Infrared in Industry.** George A. Medinger. *Enamelist,* v. 23, June '46, p. 11-18, 64.

General review of progress made in use of infrared during the war, and present applications.

7-159. **Dry Process Enameling Practice. Part 3.** W. J. Baldwin. *Finish,* v. 3, July '46, p. 17, 20-21, 50.

Enameling defects and suggestions for their reduction.

7-160. **An Approach to the Proper Method of Preparing Steel Sheets for Porcelain Enameling.** D. J. Benoliel and Walter J. Haring. *Finish,* v. 3, July '46, p. 24-26.

Comprehensive résumé of a paper before the Enamel Division of the A. C. S.

7-161. **Joint Meeting of Institution of Automobile Engineers and Electrodepositors' Technical Society.** *Journal of the Institution of Automobile Engineers,* v. 14, May '46, p. 9-22.

Aspects of finishing processes applicable to automobile engines and chassis; body corrosion; a motorcycle manufacturer's views on finish and protective coatings.

7-162. **The Chemistry and Mechanism of Steel Pickling.** Brian N. Reavell. *Foundry Trade Journal,* v. 79, June 6, '46, p. 139-141.

Principal methods that are in operation for pickling steel and the chemistry of the reactions involved.

7-163. **The Tinning of Cast Iron.** R. A. Cresswell. *Engineering,* v. 161, June 7, '46, p. 550-551.

Where articles or components can be tinned conveniently by total immersion, the nitrate method is the more flexible and reliable and has the advantage that no special tank or heating equipment is required for the fused salt. Since no previous pickling treatment is used in the chloride process, a rather higher standard of mechanical cleaning is required than that used with the nitrate process.

7-164. **Processing and Fabrication of Stainless Steel Sheet and Plate Products. Part VI—Finishing and Cleaning of Chromium-Nickel Materials.** H. S. Schaufus, W. H. Braun, and I. C. Clingan. *Steel Processing,* v. 32, June '46, p. 372-375, 388.

Mechanical finishing; wheels; abrasives; lubricants; procedures; chemical finishing; equipment; cleaning.

7-165. **Chromic Acid Anodic Solution.** *Metal Industry,* v. 68, June 14, '46, p. 477.

Summary of the conclusions of a recent investigation carried out at Consolidated Vultee Aircraft Corp. Addition of sulphuric acid to a chromic acid anodic solution produced a coating on aluminum alloy which had better corrosion resistant properties than the film produced by the standard chromic acid bath. Main drawback to this solution is that it has a severely corrosive effect on the linings of steel tanks, but it could be used satisfactorily with lead-lined tanks.

7-166. **Color—the Eye-Catcher.** *Die Casting,* v. 4, July '46, p. 62-68.

Standardized procedures for applying colorful and appealing organic finishes to many types of zinc and aluminum die castings.

7-167. **Soft Water Rinse Improves Aluminum Finishes.** Robert S. Herwig. *Iron Age,* v. 158, July 11, '46, p. 58-59.

Increasing production and lowering rejects in the electroplating or anodizing of aluminum products by use of rinse water of zero hardness after alkaline cleaning is discussed. Results obtained from a plating installation incorporating a water softening unit are described.

7-168. **"Dry" Galvanizing.** H. Bablik. *Metal Industry,* v. 68, June 21, '46, p. 487-489.

Small additions of aluminum to zinc bath combined with a low working temperature result in an improved galvanized coating together with economies in zinc wastage. Formation of dross is also considerably reduced. "Dry" process is stated to have a considerable range of application for galvanizing of shaped products, such as household utensils.

7-169. **Chemical Treatment of Highly Finished Metal Surfaces.** *Machinery,* v. 52, July '46, p. 166-168.

Simple, inexpensive treatments of machined metal surfaces have been found to be effective in aiding lubrication and preventing seizing, especially during initial running-in periods. Also prevent scuffing and welding.

7-170. **Surface Preparation Practices for Finishing Aluminum. Part I.** Arthur P. Schulze. *Organic Finishing,* v. 7, July '46, p. 9-17.

Mechanical methods; solvent degreasing.

7-171. **Aluminum Pigments.** Robert I. Wray. *Organic Finishing,* v. 7, July '46, p. 18-22.

Tables give comparative durability after nine years' exposure of two coats of aluminum paint made with aluminum pastes of different degrees of fineness; moisture impedance of aluminum paint made with fine grades of aluminum pigments in different concentrations and film thicknesses.

7-172. **Abstracts of Organic Finishing Papers Presented at the 33rd Annual Convention of the American Electroplaters' Society.** V. M. Darsey. *Organic Finishing,* v. 7, July '46, p. 23-25.

The effect of surface preparation on the durability of

organic coatings; a strippable spray-type coating; resins of the vinyl family in metal finishing; characteristics of certain plastic films and coatings.

7-173. **Blast Cleaning Materials, Methods and Equipment.** Francis L. Pettingil. *Organic Finishing,* v. 7, July '46, p. 37-41.

Airless blast cleaning plus its advantages.

7-174. **Infrared—How and When to Use It.** *Organic Finishing,* v. 7, July '46, p. 42-44.

Advantages; limitations; factors to be considered; ideal for surface coatings and finishes.

7-175. **Modern Finishing of Light Metals.** Allen G. Gray. *Light Metal Age,* v. 5, June '46, p. 16-17, 28-29.

Magnesium can be electroplated; aluminum coated steel; a new anodized finish for magnesium alloys; anodizing of aluminum benefited by glycerine.

7-176. **Descaling and Desanding Gray Iron Castings.** *Steel,* v. 119, July 15, '46, p. 104, 142.

Method makes use of sodium hydride process in connection with salt bath furnace.

7-177. **Semimechanized Pickling in United States Plants.** Paul A. Huppert. *Ceramic Industry,* v. 47, July '46, p. 58-60.

Cleaning and pickling equipment ordinarily used in American plants.

7-178. **Finishing Accessories for Refrigerators, Part 3.** John Wright. *Industrial Finishing,* v. 12, July '46, p. 60-62, 66.

How a clean air conditioned finishing room is maintained and operated under pressure so as to keep out all traces of smoke, dust or dirt, even when doors are opened.

7-179. **A Review of Inhibitors. Part I—Section B.** Wallace G. Imhoff. *Wire and Wire Products,* v. 21, July '46, p. 520-523, 542-546.

Summarizes all work done and attempts to explain clearly what takes place when inhibitors are used in acid pickling baths.

7-180. **The New Continuous Spray Machine for the Cleaning and Pickling of Metal Parts.** Wm. W. Clarke. *Enamelist,* v. 23, July '46, p. 5-9.

Description of machine; schedule of operations shows times in the various cycles are much shorter than with the usual type of immersion cleaning and pickling, yet cleaning results obtained are much superior.

7-181. **Method of Evaluating Metal Cleaners.** Samuel Spring, Howard I. Forman and Louise F. Peale. *Metal Finishing,* v. 44, July '46, p. 297-300.

Quantitative method for performance evaluation of alkaline metal cleaners involves coating of metal panels with various oils by a specific dipping and draining technique, followed by a carefully controlled cleaning and rinsing procedure. Panels are covered with a fine spray of water, which condenses as droplets on the oil-covered areas, providing a pattern that remains constant for a sufficient time for a sketch to be drawn on paper divided into 100 squares. Average value for cleaned area of five

panels is the cleaning efficiency index. (Reprinted from *Industrial and Engineering Chemistry, Analytical Edition.*)

7-182. **Polishing Methods.** E. Q. Wells. *Metal Finishing,* v. 44, July '46, p. 291-292, 300.

Selection of wheels; heading wheels; automatic polishing. Speed regulation of polishing wheel or buff is necessary for economy and finish.

7-183. **Soft-Grit Blasting.** E. C. Lathrop and S. I. Aronovsky. *Steel,* v. 119, July 22, '46, p. 102, 104, 107, 108.

Standard sandblasting equipment effective in cleaning metal surfaces, whether to remove carbon deposits, dirt, paint, varnish or lacquer. Original dimensions not altered.

7-184. **For Greater Efficiency With Polishing and Buffing Compounds.** Frank V. Faulhaber. *Products Finishing,* v. 10, July '46, p. 28-30, 32, 34, 36, 38.

Various compounds and their application.

7-185. **Grinding, Lap and Scrape Finishes at Vinco.** Bryant W. Pocock. *Products Finishing,* v. 10, July '46, p. 40-42, 44, 46, 48.

How surfaces accurate to within 2 millionths of an inch, on gages and precision inspection equipment, are produced.

7-186. **Glycerine in Anodic Treatment of Aluminum.** Georgia Leffingwell and Milton A. Lesser. *Products Finishing,* v. 10, July '46, p. 50, 52, 54, 58.

Employed in varying proportions in the electrolytic bath, glycerine generally acts as an inhibiting agent. Serves to prevent undue etching and thereby helps to provide finer, whiter, and smoother surface. In sulphuric acid baths addition of glycerine is reported to decrease solubility of aluminum and to facilitate formation of a more plastic film. 17 ref.

7-187. **Finishing Clinic.** Allen G. Gray. *Products Finishing,* v. 10, July '46. p. 62-64, 66, 68, 70, 72.

Scientific evaluation of metal cleaners; corrosion resistance of lead and lead-tin deposits on steel; importance of metal temperatures in baking of finishes; requirements for salt spray testing; refinishing procedures for magnesium.

7-188. **Sodium Hydride Descaling and Desanding of Ferrous Castings and Forgings.** *Western Metals,* v. 4, July '46, p. 35-36.

Operational procedure given.

7-189. **Metal Finishers Plan National Association.** *Iron Age,* v. 158, July 25, '46, p. 58-62.

Formation of a National Association of Metal Finishers. Papers abstracted include: observations on alkaline electro-tinning; coloring magnesium alloys; liquid polishing and buffing compounds; X-ray diffraction studies of electrodeposits.

7-190. **Aluminum Dip-Coated Steel.** *Materials & Methods,* v. 24, July '46, p. 90-94.

Heat resistance, heat reflectivity and corrosion resistance are high in this material which has found application in aircraft firewalls and flexible pipes. Sheet is continu-

ously coated by a hot dipping process patented by the American Rolling Mill Co.

7-191. **Decorative Finishes for Aluminum.** Gilbert C. Close. *Light Metal Age,* v. 5, July '46, p. 12-15.

Standard and latest methods of mechanical and chemical finishing of aluminum from the standpoint of which finish is desired.

7-192. **Silicone Enamels Aid Light Metal Photo Templet Production.** S. H. Phillips. *Light Metal Age,* v. 5, July '46, p. 17.

Material will retain photo image sharp under combined severe abrasion of press and high temperature of forming operation.

7-193. **The Chemistry and Mechanism of Steel Pickling. (Continued.)** Brian N. Reavell. *Foundry Trade Journal,* v. 79, July 4, '46, p. 247-251.

Continuous pickling; ancillary plant, acid storage and acid handling; acid heating; acid neutralization and acid recovery; materials of construction.

7-194. **Flexibility Is Important Factor in Jamestown Metal Finishing System.** John R. Morrison. *Industrial Gas,* v. 25, July '46, p. 7-9.

The flexibility of this finishing system allows work to be cleaned, prime coat dipped and baked then transferred to turntables for sanding and filling, then rebaked, transported to spray booths for the finish coat and returned again for additional baking.

7-195. **Phosphating Metallic Surfaces, Part I. History and Pretreatment.** W. G. Cass. *Chemical Age,* v. 55, July 6, '46, p. 5-8.

History of phosphating; early patents; preparing the surface; preliminary cleaning.

7-196. **Electrolytic Polishing Process for Silver.** *Western Machinery and Steel World,* v. 37, July '46, p. 112.

Method used in Westinghouse research laboratories to polish silver contactors, items of switchgear, microwave apparatus, radar sets and other experimental devices.

7-197. **Flame Fusing Protective Coatings.** *Western Machinery and Steel World,* v. 37, July '46, p. 113-115.

Minimum coat applied by Glaspray is about 6 oz. per sq. ft., but beyond this it can be piled on to any thickness. Chief advantages claimed are: comparative speed with which surfacing can be carried out; large areas and heretofore inaccessible surfaces can be coated; greater thickness that can be applied in areas subjected to severe corrosive attack; wide variety of metals that may be sprayed; and finer surface appearance.

7-198. **Vapor Degreasing.** George Black. *Materials & Methods,* v. 24, July '46, p. 95-97.

Health problems; limitations of process; carbon removal difficult Vapor cleaning method and solvents used should be chosen with full knowledge of all problems involved.

7-199. **Fighting Corrosion by Pistol.** *Sheet Metal Worker,* v. 37, July '46, p. 43-44, 48.

Life of fabricated sheet metal work prolonged by special metal and plastic coatings that protect basic metal against rust and abrasion.

7-200. **Protective and Decorative Coatings for Metals.** A. F. Brockington. *Sheet Metal Industries,* v. 23, July '46, p. 1355-1362.

General review of metal finishing processes. Tin-plate and terne-plate; zinc coatings; other cementation processes; protective treatments; decorative finishes; immersion plating; depositing metals on nonmetallic surfaces; mechanical finishing; nomenclature of finishing terms; synthetic lacquers; electrodeposition of metals; decorative finishes of gold, silver, rhodium, brass, copper, tin; anticorrosive finishes of decorative value—nickel.

7-201. **Driers and Drying Methods for Porcelain Enamel.** A. I. Andrews. *Finish,* v. 3, Aug. '46, p. 21-24.

Influence of such factors as temperature, circulation and humidity. Use of radiant heat and convection are compared, and room-type and continuous drier discussed. Constructive suggestions are offered.

7-202. **Titanium-Stabilized Iron for Enameling.** Eugene Wainer. *American Ceramic Society Bulletin,* v. 25, July 15, '46, p. 248-259.

History of the art and science of vitreous enameling. Enameling process is described and the various defects and presumed causes detailed, particularly the role of the base iron in developing such defects. Process of manufacturing enameling iron is followed by a discussion of the relative behavior of the carbides of iron and titanium in enameling stock, with particular emphasis on the role of these carbides in developing enamel defects. Manufacture of titanium-stabilized enameling iron, its properties, and its value in developing a blemish-free one-coat finish are covered.

7-203. **Fabrication and Enameling Performance of Titanium Enameling Steel.** Frank R. Porter. *American Ceramic Society Bulletin,* v. 25, July 15, '46, p. 259-266.

Results of shop-production runs of titanium enameling steel are presented, and advantages and disadvantages are pointed out. Some recommended design changes are advanced for the successful application of cover-coat enamels directly to the metal, and available comparative cost data are given.

7-204. **Hot Air Drier Doubles Galvanizing Output.** Wallace G. Imhoff. *Iron Age,* v. 158, Aug. 8, '46, p. 54-55.

Development of a new hot air drier for hot dip galvanizing operations. Drier, which replaced a steel hot plate type drier, is reported to have doubled productive capacity.

7-205. **Metal Finishing Methods Discussed.** *Iron Age,* v. 158, Aug. 8, '46, p. 68-72.

Abstracts of papers on practical aspects of electropolishing, nickel plating on steel by chemical reduction and disposing of plating room waste liquors discussed at recent annual convention of the American Electroplaters' Society.

7-206. **Finishing at Toledo's Dura Company.** Bryant W. Pocock. *Products Finishing,* v. 10, Aug. '46, p. 34-36, 38, 40, 42, 44, 46-47.

Polishing and buffing equipment and procedures.

7-207. **Preparing Steel Surfaces for Maximum Paint Adhesion.** Charles Delmar Townsend. *Products Finishing,* v. 10, Aug. '46, p. 50-52.

Tests have demonstrated that steel cleaned with Crys-Coat can be stored for 90 days without indications of rust. It is an acidic material that has wetting, penetrating and emulsifying properties.

7-208. **Electrostatic Spraying and Detearing at Japan Co.** Sanford Markey. *Products Finishing,* v. 10, Aug. '46, p. 54-56, 58.

Product is placed on a conveyer and carried to a tank where it is dipped. It is then conveyed over a drainboard and into a booth containing a highly electrified field and a grid. It is then conveyed to a drying booth containing infrared heating equipment.

7-209. **Chemical Finishing Primer.** Arthur P. Schulze. *Products Finishing,* v. 10, Aug. '46, p. 62, 64, 66, 68, 70, 72.

Black oxide finishing problems and solutions.

7-210. **Finishing Clinic.** Allen G. Gray. *Products Finishing,* v. 10, Aug. '46, p. 74-76, 78, 80, 82, 84-85.

Finishing zinc alloy die castings; buffing and polishing magnesium; influence of surface structure of steel on quality of galvanized coatings; protection of workers against solvent health hazards; effect of cleaning on the corrosion of steel; selection of baking oven for organic finishes.

7-211. **Phosphating Metallic Surfaces. Part III—Finishing Treatment.** W. G. Cass. *Chemical Age,* v. 55, July 20, '46, p. 67-70.

Essentially a review of literature and patents. Topics covered are: influence of corrosive conditions; oil adsorption powers; renewing the bath; phosphating nonferrous metals; special uses; aid to lubrication. Large number of references given within the paper.

7-212. **Buffing and Polishing, a Survey.** E. W. Wells. *Monthly Review,* v. 33, Aug. '46, p. 803-806.

Wheel speed; wheel selection; use of tallow; glue vs. cement; application of glue; application of cement; greaseless compounds; preparation for bright plating; automatic equipment; electropolishing.

7-213. **Environmental Control of Metal Cleaning Processes.** F. A. Patty. *Monthly Review,* v. 33, Aug. '46, p. 808-819.

Factors to be considered in metal cleaning; classification of cleaning processes.

7-214. **Abstracts of Papers Presented at the 33rd Annual Convention. (Concluded.)** *Monthly Review,* v. 33, Aug. '46, p. 822-826.

Practical facts about polishing and buffing compounds; resins of the vinyl family in metal finishing; strippable spray type coatings; natural and synthetic rubber in the electroplating industry; Parkerizing, growth or shrinkage;

some observations on alkaline electrotinning; electrotin plating of wide strip at high speed; electropolishing, its commercial aspects today; characteristics of certain plastic films and coatings.

7-215. **The Wetting of Steel Surfaces by Esters of Unsaturated Fatty Acids.** N. F. Miller. *Journal of Physical Chemistry,* v. 50, July '46, p. 300-319.

As part of a general investigation of adhesion of paint coatings to steel, wetting properties of a series of pure esters of common unsaturated fatty acids toward polished 48-S-5 armor plate were measured by means of contact angles. Dynamic receding angle is shown to be the fundamental criterion of film stability. "Work of adhesion" is shown to involve a force whose magnitude and effects are determined by dynamic receding angle. 15 ref.

7-216. **Scientific Evaluation of Metal Cleaners.** *Steel,* v. 119, Aug. 12, '46, p. 72-74, 106.

Positive methods for determining when metal surfaces are chemically clean: water-break method; fluorescent oil method; cleaning method; spray pattern method.

7-217. **Hot Dip Galvanizing Practice.** William H. Spowers, Jr. *Steel,* v. 119, Aug. 12, '46, p. 108-110, 130-131.

First of 14 installments containing the revised text of the author's book of the same title published in 1938. History; principles of zinc coating metal; pickling technique reviewed; two valuation methods used; porosity governs rate of corrosion.

7-218. **A Review of Inhibitors. Part II—U. S. Inhibitor Patents.** Wallace G. Imhoff. *Wire and Wire Products,* v. 21, Aug. '46, p. 598-599, 621-623.

General review of patent situation and history. List of patents from 1883 through Feb. 1936.

7-219. **Method of Evaluating Alkali Cleaners.** Claudius Nielsen. *Organic Finishing,* v. 7, Aug. '46, p. 9-13.

Method given can be relied upon to give accurate predictions of results to be expected in practical applications. Makes use of a grade of paraffin oil that is available any place and of simple and easily procured equipment.

7-220. **Modernization Doubles Finishing Capacity.** Walter Rudolph. *Organic Finishing,* v. 7, Aug. '46, p. 19-21, 36.

New setup includes a spray room and a conveyerized drying oven as the principal means of speedier, more satisfactory finishing.

7-221. **Surface Preparation Practices for Finishing Aluminum. (Concluded.)** Arthur P. Schulze. *Organic Finishing,* v. 7, Aug. '46, p. 25-30.

Chemical treatments.

7-222. **Black Anodic Coatings on Aluminum Alloys.** Robert S. Herwig. *Monthly Review,* v. 33, June '46, p. 609-611.

Method consists in treating the aluminum anodically in a solution of 15 to 25% sulphuric acid for a period of 15 to 90 min. at temperatures ranging from 67 to 88° F., and current densities of 2 to 18 amp. per sq.ft. Resulting anodic coating is immersed for 10 to 30 min. in a black dye

bath maintained at 140 to 160° F. and then sealed in either hot water or nickel acetate solution.

7-223. **Water Immersion Testing of Metal Protective Paints.** W. W. Kittelberger and A. C. Elm. *Industrial and Engineering Chemistry (Industrial Edition),* v. 38, July '46, p. 695-699.

Paint system was immersed for varying periods of time in distilled water and in solutions of sodium chloride and sucrose with osmotic pressures of 6 to 30 atmospheres. Rate and degree of water absorption and blistering were determined by extensive measurements of weight and volume changes, and by visual examination.

7-224. **Boiler Scale Removal by Chemical Cleaning.** Bradford J. Cotey *Power Plant Engineering,* v. 50, Aug. '46, p. 75-77, 124.

Cleaning boilers with acids requires careful selection and use of inhibitors. Chemical composition of scale dictates applicability of cleaning method. Oil in boiler removed by alkaline boil-out. Two common methods are fill-and-soak and pump circulation. Detailed procedures and precautions are given.

7-225. **Benjamin Installs New Continuous Furnace in Postwar Program.** *Enamelist,* v. 23, Aug. '46, p. 8-11.

Greatly increased production made possible by recent improvements in porcelain enameling department, principally a U-type continuous furnace, conveyer system, spray booths and overhead drier.

7-226. **Flame Sprayed Plastics.** Morton J. Gurdin. *Iron Age,* v. 158, Aug. 22, '46, p. 64-65.

Application of various plastics to metal by spraying finely ground powder through an oxy-propane flame is described (Schori process). Characteristics of a sprayable thermoplastic material finding wide use in the plating industry as a tank lining are discussed.

7-227. **Films and Surface Cleanliness.** Jay C. Harris. *Metal Finishing,* v. 44, Aug. '46, p. 328-330, 333.

Discusses surface films in relation to practical operations. Covers metal surfaces, films, corrosion, applications, and pickling. 14 ref.

7-228. **Metal Coloring—Coloring of Bronze.** Martin F. Maher and Franklyn J. MacStoker. *Metal Finishing,* v. 44, Aug. '46, p. 331-333.

Various formulas are given for both solid bronze and bronze plated products.

7-229. **The Effect of Various Surface Treatments in Cleaning and Preparing Copper, Nickel and Steel for Chromium Plating.** William M. Tucker and Robert L. Flint. *Metal Finishing,* v. 44, Aug. '46, p. 340-343, 345.

Details of the particular Hull cell used are given, and electrodeposits resulting from various experimental procedures described. Table presents data concerning effects of cleaning methods upon ability of the cathode surfaces to accept chromium deposits. 16 ref.

7-230. **Hot-Dip Galvanizing Practice (Continued).** William H. Spowers. *Steel,* v. 119, Aug. 26, '46, p. 100, 103-104, 106.

Development of vertical tube furnaces for galvanizing. Vertical alloy tubes radiate the heat against a large kettle of molten zinc. Major advantages of system.

7-231. **Cleaning and Painting Aluminum Chairs.** Charles G. Kipp. *Industrial Finishing,* v. 22, Aug. '46, p. 51-52, 54, 56.

Refers to aluminum lawn chair constructed of eight separate pieces of hollow aluminum tubing, six of which require a protective coating both outside and inside. Other two pieces each bent into the form of a closed rectangular loop are coated only on the outside. Metal cleaning; rinsing; acid dip and rinsing; special lacquer coating applied by dipping.

7-232. **Conveyerized Cleaning, Coating, Drying Setup.** Fred M. Burt. *Industrial Finishing,* v. 22, Aug. '46, p. 62-64, 66, 68, 72, 77, 80.

In this mechanized setup, products can be either sprayed or dip-coated and then baked in the oven. Typical coatings used include switchbox enamel and ready-mixed aluminum baking enamel.

7-233. **Tin Undercoat Improves Corrosion Resistance of Painted Steel.** E. S. Hedges and L. A. Jordan. *Paint Manufacture,* v. 16, July '46, p. 257-258.

Tin coatings as thin as 0.000008 in. were effective in preventing rust on steel sheet exposed to indoor atmosphere during experiments on the electrodeposition of tin on steel at the Tin Research Institute. Primers and test procedures are described.

7-234. **The Treatment of Steel Strip Before Fabrication.** W. F. Coxon. *Engineering,* v. 162, July 26, '46, p. 78.

Electropolishing; electrotinning; and lacquering processes.

7-235. **Polishing Methods and Technique.** L. Mable. *Journal of the Electrodepositors' Technical Society,* v. 21, 1945-1946, p. 103-112 (Reprint).

Polishing personnel; dust extracting plant; materials used in polishing; temperature of emery; Trent sand; Tripoli compo; Vienna or Sheffield lime; polishing bobs; linen, calico, fent or basil mops; polishing steel; hardened steel; speed of polishing bobs; barrel polishing; steel pressings; polishing nonferrous metals; glue; cement and size; polishing operations; steel stampings, forgings and malleable iron castings; mild steel pressings and nonferrous metals; design of articles to be polished.

7-236. **Silver Polishes.** Milton A. Lesser. *Soap and Sanitary Chemicals,* v. 22, Aug. '46, p. 42-45, 89.

Gives composition of various preparations in paste, liquid, powder, and cake form and in polishing cloths. Also describes electrolytic polishing methods. 19 ref.

7-237. **Phosphating Metallic Surfaces.** W. G. Cass. *Chemical Age,* v. 55, July 27, '46, p. 101-104.

Details of antitrust and patent litigation in the U. S.

7-238. **Resin Finishing of Refrigerator Parts.** *Materials & Methods,* v. 24, Aug. '46, p. 385-388.

Pictorial story of complete process consisting of four stages: zinc electroplating, coating with a phosphate bonding material, dip coats of primer and enamel, and electrostatic detearing.

7-239. **Static Makes Dipped Coatings Shed Tears.** Emery P. Miller. *American Machinist,* v. 90, Aug. 29, '46, p. 90-92.

Excess paint or other finishing material, which accumulates at drain-off points on dip or flow coated work, can be pulled off by an electrostatic field as a conveyer carries the parts through it.

7-240. **Modern Finishing of Light Metals.** Allen G. Gray. *Light Metal Age,* v. 4, Aug. '46, p. 16-17, 26-27.

Chemical treatments for magnesium; effect of surface preparation on the durability of organic coatings; refinishing magnesium; soft water rinse improves aluminum finishes.

7-241. **Phosphate Processes as a Pretreatment for Metal Finishing.** H. A. Holden. *Sheet Metal Industries,* v. 23, Aug. '46, p. 1539-1546.

Basic operations involved in the phosphate treatment of metal surfaces prior to organic finishing; various applications.

7-242. **The Application of Oxide Coatings to Aluminum Sheet Metal Work.** V. F. Henley. *Sheet Metal Industries,* v. 23, Aug. '46, p. 1561-1567.

Some properties of chemically and electrochemically produced oxide coatings on aluminum. A guide for sheet metal workers who are using or proposing to use oxide-coated aluminum.

7-243. **Metal Coatings on Ceramics.** E. Rosenthal. *Electronic Engineering,* v. 18, Aug. '46, p. 241-242, 262.

Methods of application with special emphasis on process whereby silver preparations containing ceramic fluxes are burned into the ceramic base.

7-244. **Double Action Cleaning Machines.** Robert Mawson. *Steel,* v. 119, Sept. 2, '46, p. 118, 151.

Double action of the machine described cleans articles quickly and efficiently without attention from the operator other than loading and unloading parts. Further advantage is that raising and lowering of the basket deposits dirt washed from parts into the bottom of the tank or drum from which dirt can be removed by opening plug drain.

7-245. **Hot-Dip Galvanizing Practice. (Continued.)** William H. Spowers, Jr. *Steel,* v. 119, Sept. 2, '46, p. 127-128.

Design and advantages of a permanent galvanizing kettle for hot-dip.

7-246. **A "Three-in-One" Plant Synchronized for Quantity Production.** Claude Cleghon. *Finish,* v. 3, Sept. '46 p. 13-16, 56.

Detailed description of equipment and methods used Plants produce table tops, sinks, bath tubs, roaster inserts, casserole units, washing machine tubs and a number of other parts.

7-247. **Furnaces and Firing Procedure, Part II.** A. I. Andrews. *Finish,* v. 3, Sept. '46, p. 17-19, 54.

Proper firing temperature and firing times; proper support for the ware; uniformity of heating and cooling; furnace atmosphere.

7-248. **The "Slump Test".** J. T. Irwin. *Finish,* v. 3, Sept. '46, p. 28-29

Suggested method for setting up enamels for spraying. Apparatus and method are simple, practical, and time-saving.

7-249. **Surface Finishes for Aluminum.** J. F. Mason. *Iron Age,* v. 158, Sept. 5, '46, p. 50-53.

Formation of electrolytic oxide coatings for protection against corrosion and abrasion. Use of various acids as well as several patented processes is discussed in detail and information is also given on electropolishing, coloring and sealing anodic films.

7-250. **Polishing and Buffing Die-Cast Auto Hardware.** Herbert Chase. *Iron Age,* v. 158, Sept. 5, '46, p. 58-61.

Methods and equipment used for polishing and buffing auto hardware preparatory to plating.

7-251. **Surfaces Finishes for Aluminum.** J. F. Mason. *Iron Age,* v. 158, Aug. 29, '46, p. 40-43.

Various chemical treatments; details as to bath composition, time, temperature and procedure.

7-252. **Environmental Control of Metal Cleaning Processes.** F. A. Patty. *Monthly Review,* v. 33, Sept. '46, p. 945-953.

Water cooled condensers vs. thermostats; solvents; trichloroethylene vs. tetrachloroethylene; stabilizers; heat source and heat controls; sludge removal; location of equipment; ventilation; common causes of solvent loss.

7-253. **Stripping of Copper. III—The Calcium Polysulphide, Sodium Cyanide Method. A.E.S. Research Project No. 1.** F. C. Mathers and Ernest L. Martin. *Monthly Review,* v. 33, Sept. '46, p. 958-962.

Results of a study of some of the variables affecting the rate of formation of copper sulphide and its dissolution in cyanide solutions. "Agricultural" lime sulphur is entirely satisfactory for this process. Calcium polysulphide content of a bath can be maintained, except for dragout, by the addition of sulphur which is readily soluble. Efforts to prolong the life of the cyanide solutions with addition agents or by regeneration were unsuccessful. Use of mechanical methods to remove a portion of the copper sulphide film prior to cyanide treatment was partially successful.

7-254. **Films and Surface Cleanliness. (Concluded.)** Jay C. Harris. *Metal Finishing,* v. 44, Sept. '46, p. 386-388.

Alkali and electrocleaning; vapor or emulsion degreasing; electroplating; surface conversion coatings; rinsing; methods of testing for cleanliness.

7-255. **The Effect of Various Surface Treatments in Cleaning and Preparing Copper, Nickel and Steel for Chromium Plating. (Concluded.)** William M. Tucker and Robert L. Flint. *Metal Finishing,* v. 44, Sept. '46, p. 389-393.

Surface preparation of buffed electrolytic copper, nickel and cold rolled steel for chromium plating.

7-256. **Continuous Spray-Pickle Machine.** Edward H. Rollfs. *Ceramic Industry,* v. 47, Sept. '46, p. 66-67.

Details of completely automatic, continuous spray pickling machine for the enameling plant installed by Landers, Frary and Clark at New Britain, Conn.

7-257. **Reclaiming Enamels Wet and Dry.** *Ceramic Industry,* v. 47, Sept. '46, p. 68-69.

Advantages and disadvantages of both methods; flow sheet.

7-258. **Survey of Methods for Cleaning Metal.** Rick Mansell. *Industrial Finishing,* v. 22, Sept. '46, p. 26-28, 30, 32, 34, 38-39.

Factory methods, materials, and equipment employed for cleaning metal surfaces.

7-259. **A New Protective Plastic.** *Machine Tool Blue Book,* v. 42, Sept. '46, p. 225-226, 228.

Possessing good electrical, physical and chemical properties, the material is tough, durable and resilient as well as water, acid and alkali resistant. Has good wet strength and will not split while it is being applied or during prolonged storage.

7-260. **Surface Protection and Decoration of Light Alloys.** H. Ronald Fleck. *Light Metals,* v. 9, Aug. '46, p. 400-404.

Account of the theory and practice of applied finishes for aluminum, with special reference to those based on the synthetic resins.

7-261. **Anodizing and Its Uses in Engine Construction.** *Light Metals,* v. 9, Aug. '46, p. 429-438.

Practice and control of anodizing, with special reference to the production of films of value in the development of improved service characteristics in internal combustion engines. Specific applications are examined. (Translated from an account by N. D. Tomashov in *"Vestnik Inzhenerov i Tekhnikov",* no. 2, 1946, p. 59-65.)

7-262. **Aftertreatment of Aluminum Alloy Castings.** E. Carrington. *Light Metals,* v. 9, Aug. '46, p. 439-450.

Various mechanical, chemical, and painting treatments as applied to castings, including sand blasting, polishing, etching, electroplating and anodizing. Operational details and formula; the various problems.

7-263. **The New Ultramodern Norris Porcelain Plant.** *Enamelist,* v. 23, Sept. '46, p. 5-16.

Porcelain enameling department of the Norris Stamping and Manufacturing Co. is highly mechanized around the world's largest U-type continuous furnace; over 2300 ft. of overhead conveyers, to handle units as large as bathtubs.

7-264. **A Modern Water-Cooled Recirculating Dip Tank.** R. H. McCaffrey. *Enamelist,* v. 23, Sept. '46, p. 17, 40.

Details of construction and operation of ground-coat enamel plant dip tank.

7-265. **Interim Descriptive Statement on the Leaching-Rate Test for Ships' Antifouling Compositions.** *Iron and Steel Institute Advance Copy,* Aug. '46, 5 p.

Test is designed to assess the value of antifouling compositions by measuring the rate of loss of toxic ingredients from the paint surface during immersion in sea water. Small glass panels coated with the antifouling compositions under test are stored in sea water and transferred periodically into the leaching apparatus, where they are subjected to agitation (by bubbling) in a definite amount of sea water for a standard time; the toxic substances leached into the water are then determined. Exact standardization of the test has not been achieved, nor has its precise significance in relation to service behavior been fully determined.

7-266. **The Formulation of Anticorrosive Compositions for Ships' Bottoms and Underwater Service on Steel. Part II.** F. Fancutt and J. C. Hudson. *Iron and Steel Institute Advance Copy,* Aug. '46, 24 p.

One hundred and twenty-seven new formulated anticorrosive paints were made and comprised various combinations of eight different mediums with mixtures of 13 different pigments. Paint No. 173, pigmented with a mixture of 2 parts of basic lead sulphate and 1 part each of white lead, Burntisland red, and barytes, and bound in a modified phenolformaldehyde litho-oil medium is suggested for general use at this stage. Several other paints gave even better performance in raft tests than paint No. 173 and merit further investigation.

7-267. **Marquette Finds Metallizing Process of Worn Parts a Maintenance Aid.** *Pit and Quarry,* v. 39, Sept. '46, p. 91-92.

Methods used by Marquette Cement Mfg. Co. for resurfacing worn parts by spraying metal wire onto a surface with a spray gun, building it up so that it can be machined to its original specifications and returned to service.

7-268. **Action of Antifouling Paints.** Bostwick H. Ketchum, John D. Ferry and Arthur E. Burns, Jr. *Industrial and Engineering Chemistry (Industrial Edition),* v. 38, Sept. '46, p. 931-936.

Antifouling paint containing rosin or other acidic resins in the matrix loses both toxic and matrix simultaneously when immersed in the sea. The loss of matrix is shown to be the result of the dissolution of acidic resin in the slightly alkaline sea water. Theoretical description of the simultaneous dissolution of toxic and matrix is presented and effects of surface residues of insoluble matrix components on the dissolution of the paint are discussed. Toxicity of the paint depends on the loading of the toxic ingredient and the solution rate of the matrix. Independent adjustment of these two variables permits great flexibility in designing a paint with the desired leaching rate.

7-269. **Gel Lacquer Technique for Protective Coating.** Carl J. Malm and Harold L. Smith, Jr. *Industrial and Engineering Chemistry (Industrial Edition),* v. 38, Sept. '46, p. 937-941.

Application of unusually heavy protective coatings depends upon gelation of lacquer by temperature change alone, without the necessity of solvent evaporation. This behavior is obtained by proper selection and balance of the solvents. Cellulose mixed esters are suitable as bases.

7-270. **Chemical Cleaning Takes the Bull Work Out of Scale Removal. I.** E. W. Feller. *Power,* v. 90, Sept. '46, p. 74-78.

First of two articles; acid solvents and additive agents.

7-271. **Hot Dip Galvanizing Practice. (Continued.)** William H. Spowers, Jr. *Steel,* v. 119, Sept. 16, '46, p. 122, 124.

Accumulation of oxides on the surface of the molten zinc and heat radiation from the top of the metal.

7-272. **Laboratory Evaluation of Corrosion Resistant Pigments and Vehicles.** Harold Zahn. *Paint, Oil & Chemical Review,* v. 109, Sept. 5, '46, p. 6-9.

New technique reflects cumulative action of all corrosion factors in a system. It is based on measurement of potential relationships between the metal base and hydrogen, using a saturated calomel electrode. In tests using two vehicles and two pigments, effects of drying time, vehicle and surface preparation were evaluated.

7-273. **Plastic Coatings for Metals.** Bernard Gould. *Modern Metals,* v. 2, Sept. '46, p. 24-25.

Method for protecting metals against corrosion. Cellulose-type plastic coating provides a moisture and corrosion proof skin which can be removed simply by peeling off. Coating material is reclaimable and transparent, or may be colored, and is easy to apply.

7-274. **Hot Dip Galvanizing.** H. J. Volker. *Corrosion and Material Protection,* v. 3, Aug-Sept. '46, p. 14, 19.

Details of the process and its advantages.

7-275. **Calorizing.** B. J. Sayles. *Corrosion and Material Protection,* v. 3, Aug-Sept. '46, p. 11-12.

The process, its applications and limitations in protecting surface of steel by formation of an iron-aluminum alloy against high-temperature oxidation and corrosion due to gaseous sulphur compounds found in the flue gases of fuel-fired furnaces. Powder processing and dip Calorizing methods compared.

7-276. **Zinc Spraying.** John Howat. *Corrosion and Material Protection,* v. 3, Aug-Sept. '46, p. 8-10.

Results obtained by process and services in which metallizing with zinc has been used.

7-277. **Packaging Equipment.** *Steel,* v. 119, Sept. 23, '46, p. 134, 136.

Method developed for preparing machines for shipment or storage involves use of vinyl resin and asphalt-gilsonite spray coatings.

7-278. **Aluminum Cleaners.** Milton A. Lesser. *Soap and Sanitary Chemicals,* v. 22, Sept. '46, p. 44-47, 169.

Reviews published information concerning suitable methods for cleaning aluminum surfaces, and gives 13 recipes for formulation of cleaners suitable for household and maintenance purposes.

7-279. **A Unique Submerged Combustion Pickling System.** J. Richard Lander. *Industrial Gas,* v. 25, Sept. '46, p. 17-18.

Installation of the Bernard Epps and Co. steel plant at Vernon, Calif.

7-280. **Hot Dip Galvanizing Practice. (Continued.)** William H. Spowers, Jr. *Steel,* v. 119, Sept. 30, '46, p. 74, 76, 78, 102, 105.

Fluxes used are hydrochloric acid, with or without sal ammoniac, zinc ammonium chloride, and zinc chloride; their advantages and limitations; fluxing practice.

7-281. **Treatment of Iron and Steel Used in Building Construction.** A. R. King. *Paint Manufacture,* v. 16, Aug. '46, p. 283-287.

Recommends use of a metallic coating and two coats of paint, or a phosphate coating and three coats. Discusses conditions affecting durability, methods of application and pros and cons of phosphating.

7-282. **The Adhesion of Paint Films on Metal.** E. Karsten. *Paint Manufacture,* v. 16, Aug. '46, p. 304.

Fourteen types of metal sheet were coated with six types of paint and then exposed to a salt spray test. Adhesion values were obtained after 3, 10, and 18-day periods and the paints were classified in order of decreasing adhesiveness; also, the metal surfaces were classified according to suitability as a base for paint films. (Abstract from *Zeit. Metall und Schuuckwaren-Fabrikate Verchrom,* v. 23, '42, p. 197-200.)

7-283. **Reo Finishes Lawn Mowers.** *Products Finishing,* v. 10, Sept. '46, p. 42-44, 46, 48, 50, 52.

How various parts for machines are prepared for finishing and how they are finished.

7-284. **Finishing Clinic.** Allen G. Gray. *Products Finishing,* v. 10, Sept. '46, p. 54, 56, 58, 62, 64, 66, 68, 70, 72.

New plastic coating method employs gel lacquers; electropolishing—its commercial aspect today; reprocessing porcelain enameled parts; blackening process for stainless steels; vapor degreasing offers efficiency and economy in finishing operations; a bronze plating bath.

7-285. **Physical and Chemical Phenomena That Account for Red Lead's Metal Protective Ability.** E. J. Dunn, Jr. *Official Digest,* Sept. '46, p. 375-383.

Experimental data on water permeability, water sorption, chemical reactivity, acid number, and other properties of commonly used paint pigments help to explain red lead's ability to prevent metal corrosion.

7-286. **Dodge Sprays Paint Automatically on Fenders and Hoods.** Rupert LeGrand. *American Machinist,* v. 90, Oct. 10, '46, p. 133-135.

Large-area sheet-metal parts of changing contour can be painted by machine if work rotation and spray arm travel are coordinated. Equipment and operations involved.

7-287. **Hot-Dip Galvanizing Practice. (Continued.)** William H. Spowers, Jr. *Steel,* v. 119, Sept. 23, '46, p. 149-150, 153.

Discussion of dross contamination shows that each of the four causes enumerated is closely related and, to a large extent, controlled by the type and design of the installation itself. (To be continued.)

7-288. **Roller Coating Aluminum.** Herschel E. Post. *Organic Finishing,* v. 7, Sept. '46, p. 43-44.

Brief description of technique which, together with new primer, made it possible for a crew of six men to process 350 aluminum sheets per hour. Before roller coater was devised same crew was able to turn out manually from 18 to 20 sheets an hour.

7-289. **The Evaluation of Protective Coatings.** D. A. Hilliard. *Organic Finishing,* v. 7, Sept. '46, p. 31-33, 36-42.

Various methods which have been developed for controlling the film thickness of test panels. Describes the following tests: hardness or mar resistance, abrasion resistance, distensibility, adhesion, moisture resistance, salt spray resistance, outdoor exposure resistance, soap resistance, food acid and grease resistance, heat resistance, and resistance to production line conditions.

7-290. **Automatic Spray Enameling.** *Steel,* v. 119, Oct. 7, '46, p. 124.

Machine developed by Ferro Enamel Corp., Cleveland, for automatic spraying of porcelain on the interior of hot water tanks.

7-291. **Hot-Dip Galvanizing Practice. (Continued.)** William H. Spowers, Jr. *Steel,* v. 119, Oct. 7, '46, p. 134, 137, 172-174.

Preparation of the solutions for galvanizing; details of the results of variations in quantities of salts and in techniques. (To be continued.)

7-292. **Polishing Technique.** L. Mable. *Metal Industry,* v. 69, Aug. 30, '46, p. 182-184.

Choice of personnel; shop layout; polishing materials; polishing bobs; speed of polishing; polishing steel; heat treated parts; nonferrous metals; polishing operations.

7-293. **Advancements in Nickel-Dipping Practice.** G. H. McIntyre. *American Ceramic Society Bulletin,* v. 25, Sept. 15, '46, p. 333-337.

Importance of acidity and nickel content; pertinent variables in operation, and general effects of nickel treatment, in relation to blue ground-coat enamel and particularly, white enamel applied directly to steel.

7-294. **Factors Governing Adherence of Enamels Applied to Sheet Iron.** L. A. Johnson and E. E. Howe. *Journal of the American Ceramic Society,* v. 29, Oct. 1, '46, p. 296-301.

A series of tests were conducted to ascertain the effect of nickel deposition and firing variations upon the adherence of enamels applied to special enameling sheets. Limits were established for securing optimum adherence of zirconium-opacified white, antimony-molybdenum-opacified white, and commercial blue ground-coat enamels.

7-295. **Modern Metal Protection.** *Steel,* v. 119, Oct. 14, '46, p. 108-109, 144, 146, 148, 150, 152, 154, 156, 158, 161, 162, 164, 166, 168.

Basis for comparison of various methods of metal protection is provided by data which have been assembled from following papers presented before a joint symposium organized by the Cleveland sections of the Electrochemical Society, American Chemical Society, and American Institute of Chemical Engineers: Factors in Corrsion Control, by H. H. Uhlig; Plastic Coatings to Control Metal Corrosion, by S. P. Wilson; Clad Steel Processing Equipment for Chemical and Allied Industries, by E. C. Gosnell; Preparation of Metals for Painting, by R. E. Gwyther; Function of Specification in Electroplating, by C. E. Huessner, Carl O. Durbin, and D. W. Munro; Problems of Automotive Cooling System Corrosion Inhibition, by D. H. Green and R. A. Willihnganz.

7-296. **A "Three-in-One" Plant Synchronized for Quantity Production. Part II (Unit 3—the Tile Line).** Claude Cleghon. *Finish,* v. 3, Oct. '46, p. 26.

New ground-coat furnace and dryer. Pictures show tile line in operation.

7-297. **A New Method of Protecting Machines for Shipment or Storage.** *Machinery,* v. 53, Oct. '46, p. 154-156.

Describes "cocoon" method for protecting machinery or other objects for shipment or storage—a method by which outdoor storage is feasible with the assurance of complete protection Method consists of spraying plastic covering around—not on—the object to be protected.

7-298. **Modern Finishing for Metals and Plastics.** Harry Forsberg. *Industrial Heating,* v. 13, Sept. '46, p. 1495-1496, 1498, 1500, 1502-1504.

Brief account of operations at Japan Co., Cleveland, covering cleaning, finishing methods, electrostatic spraying, hand spraying.

7-299. **A Review of Inhibitors. Part III.** Wallace G. Imhoff. *Wire and Wire Products,* v. 21, Sept. '46, p. 673-674, 700-701.

Bibliography of 119 references arranged alphabetically by authors.

7-300. **Metal Polishing.** R. Macnair. *Sheet Metal Industries,* v. 23, Sept. '46, p. 1746-1750.

Practical hints on equipment and technique.

7-301. **Protective and Decorative Coatings for Metals. (Continued.)** A. F. Brockington. *Sheet Metal Industries,* v. 23, Sept. '46, p. 1751-1755.

Bright chromium plating; hard chromium deposition; speculum plating; anticorrosive finishes—lead, indium, zinc, and cadmium; anodic oxidation of aluminum; Bengough process; sulphuric acid process; comparison of processes; oxalic acid process; Brytal anodic process; chromating of magnesium; electropolishing.

7-302. **Degreasing and Deoxidizing Aluminum for Spot Welding.** Arthur P. Schulze. *Light Metal Age,* v. 4, Sept. '46, p. 11-13.

Various surface cleaning techniques available; mechanical means of oxide removal; chemical methods of deoxidizing.

7-303. **Deposition of Metal on Plastics.** E. A. Ollard and E. B. Smith. *Plastics,* v. 10, Sept. '46, p. 470-475, 506.

Types of plastics; adhesion of the coating; plating process; cleaning the surface; waterproofing; bronze powder and graphite process; choice of graphite; use of copper powder; enhancing conductance of current; vacuùm sputtering; vaporization in vacuo; spraying. (To be continued.)

7-304. **The Effectiveness of Paint in Suppressing Galvanic Corrosion.** G. W. Seagren, G. H. Young, and F. L. LaQue. *Corrosion,* v. 2, June '46, p. 67-77.

Tests were made using test panels consisting of two different metals bolted together and immersed in sea water and painted with various types of paint. Effects of painting anode areas only and cathode areas only were evaluated in separate series. Results are summarized and recommendations made.

7-305. **Permeability and Corrosion in Protective Coatings.** D. F. Siddall. *Corrosion,* v. 2, June '46, p. 78-84.

Permeability and polymer films; protective coatings and polymers; protective coatings and permeability; chemical attack and permeability.

7-306. **Hot-Dip Galvanizing Practice. Part 9.** William H. Spowers, Jr. *Steel,* v. 119, Oct. 21, '46, p. 118, 121, 137-141.

Pickling and galvanizing procedure.

7-307. **Painting of Steel Ships by Wet Blasting Method.** Charles Hamilton. *Paint, Oil & Chemical Review,* v. 109, Oct. '46, p. 43-44.

Methods used for preparing the hulls for painting and for application of the Navy's hot-plastic antifouling paint.

7-308. **Action of Pigments in Anticorrosive Paints.** *Paint, Oil & Chemical Review,* v. 109, Oct. '46, p. 46.

Author doubts validity of theories for corrosion protective action of zinc chromate based on assumption that chromate ions come into direct contact with the metal surface and react with it chemically. Advances theory that beneficial influence of zinc chromate is the result of chemical reaction with the binding medium which leads to the formation of soaps and to more resistant films. (Condensation of paper by H. Wagner, *Korrosion & Metallschutz,* v. 20, '44, p. 221-224.)

7-309. **Modern Finishing for Metals and Plastics. Part II. (Concluded.)** Harry Forsberg. *Industrial Heating,* v. 13, Oct. '46, p. 1653-1654, 1656, 1658, 1660, 1662-1663.

Dipping and electrostatic detearing, roller coating, silk screening and plastics finishing operations. Assembly of finished parts, special finishing materials and laboratory and shop facilities.

7-310. **Engineering an Anodizing Installation.** Robert S. Herwig. *Metal Finishing,* v. 44, Oct. '46, p. 423-425.

Details of the following items for sulphuric acid anodizing of aluminum: source of d.c. supply; cleaning bath; rinse and anodizing tanks; dye and sealing baths; aluminum racks and wire.

7-311. **Bright Dipping.** Gustaf Soderberg. *Metal Finishing,* v. 44, Oct. '46, p. 433-434.

Defines bright dipping and reviews existing bright-dipping processes for copper and its alloys, cadmium plate

and zinc plate, magnesium and lead. Applications are listed and discussed. A theory of bright dipping, paralleling that for anodic brightening, is proposed. 22 ref.

7-312. **Mechanization Slashes Costs on Deburring and Polishing.** Frank M. Scotten. *Production Engineering & Management,* v 18, Oct. '46, p. 51-54.

Roto-finishing process which has effected a substantial saving in processing costs, more uniformity in producing radii and breaking sharp edges; provides surface finishes that are more uniform and that are quite apt to show a lower micro-inch reading than parts finished by hand. Dimensional loss has been brought under control through elimination of the human element, and the burden on personnel has been lightened.

7-313. **Cleaning and Finishing Metal Dinette Furniture.** R. C. Root. *Industrial Finishing,* v. 22, Oct. '46, p. 34-38, 40.

Noblitt Sparks Industries' setup for cleaning and spray coating table tops, chair seats and backs of modern chrome trimmed dinette sets.

7-314. **Stop Paint Blisters on Aluminum Castings.** Seymour Wattenburg. *Industrial Finishing,* v. 22, Oct. '46, p. 42, 44, 46, 48.

Specific examples of processing where blistering occurred; sandblasting method eliminated the condition.

7-315. **Finishing Operations at Kaiser-Frazer Willow Run Plant.** Bryant W. Pocock. *Products Finishing,* v. 11, Oct. '46, p. 34-36, 38, 40, 42, 44.

Details of mechanical finishing, cleaning, Bonderizing and painting.

7-316. **Finishing Clinic.** Allen G. Gray. *Products Finishing,* v. 11, Oct. '46, p. 56, 58, 62, 64, 66, 68, 70, 72.

Flame priming offers a method of preparing steel surfaces for painting. Vinyl resin finishes due for expansion. Liquid polishing and buffing compounds may offer advantages. Soft water rinse improves aluminum finishes. Microbarrel plater proves useful in many finishing operations. New methods for hot dip tinning of cast iron.

7-317. **Finishing a Modern Refrigerator.** Burr Price. *Products Finishing,* v. 11, Oct. '46, p. 74, 76, 78, 80.

Equipment and operations in paint department and porcelain enamel department.

7-318. **Barrel Finishing of Metal Products.** H. Leroy Beaver. *Products Finishing,* v. 11, Oct. '46, p. 82-84, 86, 88, 90.

Reviews the various types of barrels available and summarizes the results that might be reasonably expected from the use of these barrels.

7-319. **Blisters in Porcelain Enameling.** Ralph L. Cook. *Enamelist,* v. 23, Oct. '46, p. 5-8, 54, 56-57.

Lists the direct causes of blistering and suggests some remedies.

7-320. **New Moffat Porcelain Enameling Plant.** *Enamelist,* v. 23, Oct. '46, p. 14-17, 60.

General layout, procedures and equipment.

7-321. **The Chemistry of the Balanced Action Pickling Process.** T. P. Hoar. *Sheet Metal Industries,* v. 23, Oct. '46, p. 1976.

Comment on the de Lattre pickling process, intended to clarify certain points brought up in previous discussion. Several criticisms of the chemical theory presented by de Lattre are elucidated.

7-322. **Gel Lacquer Coatings.** *Steel,* v. 119, Oct. 28, '46, p. 76-77, 98, 100, 105.

New way to apply a durable "plastic veneer" finish by dipping articles in a gel-forming cellulose-ester lacquer. Preparation of gel, equipment required, application, maintenance of compositions, precooling of the core, and pretreatment of the core.

7-323. **Hot Dip Galvanizing Practice. Part X.** William H. Spowers, Jr. *Steel,* v. 119, Oct. 28, '46, p. 114, 116, 126, 128, 130.

Development of deep-fired full-capacity settings; perfection of the No. 20 neutral fluxing technique for galvanizing wire.

7-324. **Discussion on Metal Finishing Requirements of the Automobile Industry.** *Journal of the Electrodepositors' Technical Society,* v. 21, '46, p. 149-170. (Reprint.)

Discussion was commenced with three short papers. "Aspects of Finishing Processes to Automobile Engines and Chassis", by H. H. Jackson; "Body Corrosion Troubles", by J. R. Stanfield; and "A Motor-Cycle Manufacturer's Views on Finish and Protective Coatings", by V. Page. Various phases of electrodeposition materials costs and design were covered in discussion.

7-325. **Metal Cleaning Technique in Prefabricated Steel Housing Production.** R. H. Martin. *Western Metals,* v. 4, Oct. '46, p. 21-23.

Materials; production layout; mill scale; controls; analyzing deposits; determining cleaner; rust removal; welding requirements; etching.

7-326. **Liquid Honing as a Production Method.** *Western Metals,* v. 4, Oct. '46, p. 31-32.

Process is based on the use of fine abrasive substances mixed with a chemical emulsion and discharged by compressed air against the metal surface to be polished or finished.

7-327. **Anodizing—a Commentary.** Peter Smith. *Light Metals,* v. 9, Oct. '46, p. 515-516.

Critical comments on following papers which were published in the August issue: "Anodizing and Its Uses in Engine Construction", by N. D. Tomashov; and "After-Treatment of Aluminium Alloy Castings", by E. Carrington.

7-328. **Testing Pickling Solutions.** *Ceramic Industry,* v. 47, Oct. '46, p. 72, 74.

Methods applied in checking each of the solutions used in enamel plant pickling rooms.

7-329. **This West Coast Plant Can Produce Porcelain Enameled Water Heaters in Quantity.** Gerald Eldridge Stedman. *Finish,* v. 3, Nov. '46, p. 13-16.

Plant layout, equipment and procedures.

7-330. **Equipment Considerations for Automatic Cleaning and Pickling.** Nathan Ransohoff. *Finish,* v. 3, Nov. '46, p. 20, 22.

The "grasshopper" type machine for continuous pickling in which work is loaded into crates or hung from fixtures. Crate or fixture. after loading, is hung onto the conveyer chains of the machine at the charging end and advances automatically through the various processes. Refers specifically to its use for pickling shell cases, and the problem of trapping air and drainage of shells.

7-331. **Continuous Spray Equipment as Applied to Cleaning and Pickling.** W. W. Clarke. *Finish,* v. 3, Nov. '46, p. 21-22.

Development of a unit for the complete cleaning and pickling cycle of metal parts prior to enameling. Describes machine and its parts and gives operating data.

7-332. **Study the Cleaning Job—Then—Engineer the Equipment.** John M. Bash. *Finish,* v. 3, Nov. '46, p. 23-24, 54, 56.

Advice on metal cleaning keyed to both ceramic and organic finishing plants.

7-333. **Phosphatization of Steel Parts.** *Chemical Engineering,* v. 53, Oct. '46, p. 293-294.

Effects of various compositions were investigated and the results summarized. (Condensed from "Effect of the Composition of Phosphorus-Manganese Preparations on the Phosphatization of Steel Parts". A. A. Sokolovsky and Z. M. Koulagina. *Zhurual Prikladnoi Khimii,* v. 18, no. 7-8, '45, p. 412-419.)

7-334. **Drying Industrial Finishes on Metals.** H. R. Clauser. *Materials & Methods,* v. 24, Oct. '46, p. 910-911.

Pros and cons of infrared heating.

7-335. **Spraying Compositions to Buffs.** John F. Siefen. *Monthly Review,* v. 33, Nov. '46, p. 1181-1183.

Method for the application of liquid compounds to revolving buffs in the production of satin and mirror finishes. It is claimed to be more economical than the use of compound bars because of lower consumption of compound and buffs, more efficient utilization of labor and less hazard.

7-336. **Finishes for Aluminum.** R. E. Pettit. *Product Engineering,* v. 17, Nov. '46, p. 113-120.

Mechanical, chemical, organic, and electrolytic treatments.

7-337. **A Comparison of Cleaning Processes for Die Castings.** Carl Von Sonnenberg. *Die Castings,* v. 4, Nov. '46, p. 55, 57-58, 60, 62.

Hot tank cleaning; cold tank cleaning; electrocleaning; mechanical washing machines; vapor degreasing; organic solvents.

7-338. **Adhesion of Industrial Finishes on Nonferrous Metals.** M. Hess. *Organic Finishing,* v. 7, Oct. '46, p. 15-21.

Deals with the problems of adhesion mainly from a technological aspect. Adhesion of a coating on a base is considered in relation to the forces which are involved when an elasticity test (bending test) or a cutting test (with a knife) is executed.

7-339. **Automatic Dip Finishing.** Frank V. Faulhaber. *Organic Finishing,* v. 7, Oct. '46, p. 27, 29-33.

Installations for processing small units with high production run, to double-dip transformer coils and for processing corrugated sheet steel. Includes details of equipment.

7-340. **New Coatings and Applications Expand Use of Porcelain Enamel.** *Steel,* v. 119, Nov. 11, '46, p. 154, 156, 218, 220, 222.

Development of high-temperature coatings suitable for industrial melting pots, aircraft and marine exhaust systems, and refinement of spraying techniques, widens range of applications.

7-341. **Cleaning Protects Life of Wire Mill Dies.** *Steel,* v. 119, Nov. 11, '46, p. 180, 183, 240, 242.

Digest of papers presented at annual meeting of Wire Association: establishment of time cycle for removal of scale from surfaced wire is recommended; cobalt smear on surface of carbide die shortens service of die; three steps in preparation of metallographic specimens greatly simplify method of polishing.

7-342. **Controlled Chemical Cleaning.** Robert V. Gardner. *Western Machinery and Steel World,* v. 37, Oct. '46, p. 104-107, 128.

Hot tank cleaning; cold tank cleaning; electrocleaning.

7-343. **Modified Chromic Acid Anodizing Process for Aluminum.** C. J. Slunder and H. A. Pray. *Metal Finishing,* v. 44, Nov. '46, p. 479-483.

Process in which bath maintenance is achieved by sulphuric acid additions. The sulphate content of such baths introduces corrosion difficulties when steel tanks are used. However, with protected tanks and carbon cathodes and by controlling the operation on the basis of anode current density, the process appears from the laboratory test to offer promise of a considerable saving in chromic acid consumption. The relations between current density, voltage, sulphate content, and coating weight are described.

7-344. **Metal Cleaning, Finishing, Protection.** *Metal Progress,* v. 50, Nov. '46, p. 1061-1076, 1078, 1080.

Group of papers organized by Adolph Bregman includes: Postwar Metal Finishing, Adolph Bregman; Principles of Metal Cleaning, Jay C. Harris; Postwar Metal Cleaning Methods, Lionel De Waltoff; Wartime Electroplating, George B. Hogaboom; Plating on Plastics, Harold Narcus; Electropolishing in Postwar Finishing, Charles L. Faust; Polishing and Buffing, Henry L. Kellner; Recent Publications on the Testing of Metallic Finishes, Myron B. Diggin and Otto Kardos (includes 27 ref.); Postwar Paints and Painting Methods, E. A. Zahn; and Postwar Organic Finishes, Gustave Klinkenstein.

7-345. **Porcelain Enameling Characteristics of Some Common Ferrous Metals.** W. A. Deringer. *Journal of the American Ceramic Society,* v. 29, Nov. 1, '46, p. 332-340.

Five common commercial ferrous metals, hydrogen annealed S.A.E. 1010 steel, and carburized titanium-bearing enameling iron, were coated with porcelain enamel and

subjected to various tests. Results indicate relationship between the hydrogen behavior and enameling characteristics which can best be explained on the basis of diffusibility of atomic hydrogen through the metal and is in no way affected by the total carbon content or by the stabilization of the carbon through the formation of carbides other than iron carbide.

7-346. **Mechanical Pickler Cuts Time and Costs.** *Inco,* v. 20, Fall '46, p. 24-25.

Equipment developed by Youngstown Welding and Engineering Co. will reduce pickling time by 40 to 60%. Saves steam, labor, and maintenance and releases cranes for other duties.

7-347. **Barrel Finishing of Metal Products. Part 3.** H. Leroy Beaver. *Products Finishing,* v. 11, Nov. '46, p. 44, 46, 48, 50, 52, 54, 56.

Care, maintenance and reclamation of steel burnishing materials.

7-348. **Finishing Clinic.** Allen G. Gray. *Products Finishing,* v. 11, Nov. 11, '46, p. 66-68, 70, 72, 74, 76, 78.

Chemical treatments for finishing magnesium; aluminum can be finished with porcelain enamel; buffing and coloring zinc die castings; applications for solvent emulsion cleaners.

7-349. **Soap in Metal Products Finishing.** Georgia Leffingwell and Milton A. Lesser. *Products Finishing,* v. 11, Nov. '46, p. 80-82, 84, 86, 88.

Use of aqueous solutions of soap and soap-alkali in removing oils, greases, and waxes and various types of dirt incidental to producing and fabricating metal objects.

7-350. **Infrared Degreasing.** *Steel,* v. 119, Nov. 18, '46, p. 104, 139.

Production-line installation uses 17-ft. furnace with 832 lamps to burn grease from metal chair frames in 2½ min.

7-351. **Hot Dip Galvanizing Practice. Part XI.** William H. Spowers, Jr. *Steel,* v. 119, Nov. 18, '46, p. 112-114.

For pickling pipe, batch pickling, if properly handled, is sufficiently effective. Technique for galvanizing of pipe fittings. (To be continued.)

7-352. **Dip Finish for Light Metals.** *Modern Metals,* v. 2, Nov. '46, p. 37-38.

Preparation of Tenite II gel lacquer and the dipping process; advantages and limitations.

7-353. **Cleaning Engine Components.** *Steel,* v. 119, Nov. 18, '46, p. 108, 139.

Automatic washing machines remove dirt from diesel engine blocks, heads and smaller parts.

7-354. **A Study of Primers for Ferrous Metals in an Atmospheric Exposure.** *American Paint Journal (Convention Daily),* v. 31, Nov. 6, '46, p. 34-35.

Results of New England testing of a large number of primer formulations on cold rolled steel panels and hot rolled angle irons are presented in a table.

7-355. **Infrared in Metal Finishing.** Joseph M. Oxenhorn. *Organic Finishing,* v. 7, Nov. '46, p. 9-13, 16.

Theory of infrared, touching only briefly on its practical application.

7-356. **Finishing Hospital Equipment.** Walter Rudolph. *Organic Finishing,* v. 7, Nov. '46, p. 26-30.

Brief account of finishing room equipment and processes.

7-357. **Finishing Aluminum. Part I.** Rick Mansell. *Organic Finishing,* v. 7, Nov. '46, p. 31-33, 36, 41.

Precleaning by emulsion degreasing; mechanical parts washing; vapor degreasing; alkaline hot tank precleaning; surface cleaning.

7-358. **The Preparation of Test Panels.** George Black. *Organic Finishing,* v. 7, Nov. '46, p. 38-41.

Panels required for the variety of tests in Federal Specification TT-P-141a of four types of steel, tin, glass and wood; preparation of each.

7-359. **Electrostatic Painting.** Vin Zeluff. *Scientific American,* v. 175, Dec. '46, p. 252-254.

Electronic equipment which minimizes overspray waste and blisters in industrial finishing. The paint particles leaving the spray gun are drawn to the surface to be coated by an electrostatic field. Similar devices, working in reverse, remove excess paint and prevent unsightly tears.

7-360. **Cleaning and Finishing Aluminum Products.** Tom Winshurst. *Industrial Finishing,* v. 23, Nov. '46, p. 32-36, 38-40.

Four methods of surface preparation before painting such products as flat sheets, Eskimo Freeze shells, various deep drawn articles and new aluminum furniture.

7-361. **Materials and Technique for Finishing Metal Grave Vaults.** F. Hagan. *Industrial Finishing,* v. 23, Nov. '46, p. 50, 52, 56, 58, 60, 62, 64, 66.

A few of the many decorative wrinkle finishes that are especially suitable for a variety of new products made of metal.

7-362. **Hot-Dip Galvanizing Practice. Part XIII.** William H. Spowers, Jr. *Steel,* v. 119, Nov. 25, '46, p. 88-90, 92.

Sheet galvanizing method usually used results in relatively thin coatings which are not too satisfactory. Also, the output of "seconds" is excessive. Suggests changes in present practice to overcome these difficulties. Describes semicontinuous and continuous galvanizing lines.

7-363. **Maintenance of Oil Field Equipment.** D. R. Hiskey. *Corrosion,* v. 2, Nov. '46, p. 235-248.

Five requirements of satisfactory corrosion-preventing coatings for metals, with particular reference to oil field equipment.

7-364. **Precision Tumbling of Metal Parts.** R. M. Lord. *Materials & Methods,* v. 24, Nov. '46, p. 1227, 1229.

Gears can be deburred in a fraction of the time required with conventional methods and with a corresponding reduction in cost, using precision abrasive tumbling.

7-365. **Cleaning Aluminum Before Welding With Inert-Arc Method.** M. J. Conway. *Materials & Methods,* v. 24, Nov. '46, p. 1230.

Dips in sodium hydroxide and sulphuric acid produce mirror-bright, fine-contoured welds as welded.

7-366. **The Technique of Fabricating "Rubber Plated" Metal.** W. S. Long. *Western Metals,* v. 4, Nov. '46, p. 16-19.

Various applications of rubber lining, properties, processes, curing, adaptability, and types of linings.

7-367. **Les Revetements Metalliques et la Protection Superficielle Des Pieces Moulees. (Metallic Coatings and the Surface Protection of Castings.)** Marcel Ballay. *Fonderie,* no. 8, Aug-Sept. '46, p. 285-300.

Methods of surface treatment of castings such as metallic and nonmetallic coating, physico-chemical treatment (through adsorption or diffusion), chemical (oxidation, phosphating, bonderizing, etc.) and electrochemical (anodic oxidation). Descriptions of the methods and their application under different conditions are given.

7-368. **Sprayed Aluminum for Corrosion Prevention.** A. F. Shepard. *Aluminum and Magnesium,* v. 3, Nov. '46, p. 6-7, 9, 24.

Equipment and process for metal spraying; procedure for spraying aluminum as a protective coating on iron and steel; advantage as base for paints; applications to nine general classes of work.

7-369. **Etat de Surface Chimique et Passivation d'Aciers Doux et a Faibles Teneurs en Additions. (Chemical State of Surfaces and the Passivation of Mild Steels and Steels of Low Alloy Content.)** E. Herzog. *Metaux Corrosion-Usure,* v. 20, Oct. '45, p. 127-134.

A new method of surface treatment of mild steels and steels with low alloy content inducing the passivity of such surfaces and thus increasing their corrosion resistance is proposed. This method consists of preliminary dipping in nitric acid followed by dichromate treatment for 10 to 15 min. at 100° C. Passivity disappears when the surface is heated above 60° C.

7-370. **Electropolishing—What Is Its Status Today.** Charles L. Faust. *Journal Electrodepositors' Technical Society,* v. 21, '46, p. 181-194. (Reprint.)

History of electropolishing; patent situation. Pertinent patents are shown in table listing types of solutions covered. Practical aspects of electropolishing; metals electropolished; electropolishing baths; costs, methods, and future of electropolishing. 20 ref.

7-371. **Anodic Treatment of Aluminum.** *Aluminium and the Non-Ferrous Review,* v. 2, July-Sept. '46, p. 58, 60-62.

Reviews German and Japanese processes for anodic oxidation of aluminum, then describes briefly English development work on the process, including superposition of a.c. on d.c. for better quality films, production of waterproof films, and utilization of the film porosity for certain applications. Commercial practice, covering pretreatment and electrical equipment in this installment. (To be continued.)

7-372. **Phosphate-Coated Car Bodies.** *Machinery (London),* v. 69, Oct. 31, '46, p. 545-549.

Phosphate coating line for Mercury bodies where one goes through line every 2 min.

7-373. **De-Enameling.** G. H. Spencer-Strong. *Steel Processing,* v. 32, Nov. '46, p. 718-723.

Various chemical and mechanical methods; advantages of sandblasting process.

7-374. **Hot Dip Galvanizing Practice. (Concluded.) Part XIV.** William H. Spowers, Jr. *Steel,* v. 119, Dec. 2, '46, p. 123, 126, 129.

Equipment, materials and techniques involved when galvanizing such articles as pails, tubs, garbage cans, ash cans, funnels, oil cans.

7-375. **High-Temperature Ceramic Coatings.** D. G. Bennett. *Finish,* v. 3, Dec. '46, p. 13-17, 50.

Heat resistant ceramic coatings can be used to protect metals from the effects of high temperatures for long periods of time; mild steel can be used at considerably increased temperatures when proper ceramic coatings are applied; a new conception of firing technique is involved; and test methods must include all of the unusual conditions to which high temperature coatings would be subjected in actual service. Illustrations of specimen preparation and test results.

7-376. **Production and Enameling Problems With Non-enameling Iron.** D. S. Beal. *Finish,* v. 3, Dec. '46, p. 18, 50, 52.

Problems involved when using steel sheets; some precautions to be observed.

7-377. **Automatic Cleaning and Pickling Prior to Porcelain Enameling.** Leroy Camel. *Finish,* v. 3, Dec. '46, p. 19-21, 48.

Manual and automatic equipment, materials, and processes.

7-378. **Modern Finishing of Light Metals.** Allen G. Gray. *Light Metal Age,* v. 4, Nov. '46, p. 20-21, 23.

Recommendations for preparation of aluminum and magnesium for painting; precleaning with solvent emulsions may prove useful; colored anodic coatings on aluminum.

7-379. **New Metalizing Technique "Homogenizes" Alloy Coatings to Eliminate Porosity.** J. A. Looney. *Petroleum Processing,* v. 1, Dec. '46, p. 290, 292, 294.

Area to be coated is machined to the desired depth as in conventional practice, but is left as smooth as possible rather than threaded or knurled. Next, the surface is pitted by means of multiple electric arcs until the area contains thousands of tiny depressions. After this preparation, metal spraying must be done immediately. Flaming the coating until all porosity is eliminated closely follows spraying.

7-380. **Metal Coated Plastics.** *Modern Plastics,* v. 24, Dec. '46, p. 106-108.

Numerous applications, several of which take advantage of the electrical conductivity of metal and the insulating

properties of the plastics. Newest application is a radio chassis in which the metal connections are sprayed on the plastic housing in one operation. The sprayed metal forms strips about 1/10 in. wide and 1/5000 in. thick, eliminating the need of a soldering iron in radio assembly.

7-381. **New Surface Treatment for Aluminum.** J. Anthony. *Iron Age,* v. 158, Dec. 5, '46, p. 64-67.

New chemical rustproofing treatment called Alodizing is said to provide a uniform and highly integrated coating at low cost and with comparatively short immersion time. Equipment and procedure for applying the coating.

7-382. **Problems in Porcelain Enameling Nonenameling Sheets.** W. A. Deringer. *Ceramic Industry,* v. 47, Dec. '46, p. 73, 76, 78.

Warpage of the ware; primary boiling; defects caused by deoxidized scale; steel blisters; pickling difficulties; copperheads; fish scaling; blistering; fabricating difficulties. (To be continued.)

7-383. **Manufacturing Abrasive Buffing and Polishing Wheels.** John E. Hyler. *Steel,* v. 119, Dec. 9, '46, p. 86-87, 142, 144.

Some of the techniques employed in preparing abrasives and setting up polishing wheels. (To be continued.)

7-384. **Anodized Domestic Ware.** Max Schenk. *Light Metals,* v. 9, Nov. '46, p. 575-592.

Potentialities of anodic treatment in relationship to possible and desirable improvements in domestic utensils in light metal. Advantages and disadvantages, and the need for systematic introductions of such processed ware.

7-385. **Protective Coating Compositions for Wire.** C. C. Downie. *Paint Manufacture,* v. 16, Nov. '46, p. 388-390.

Characteristics of these materials and methods used in application.

7-386. **Marine Corrosion and Fouling. Part II.** H. W. Rudd. *Paint Manufacture,* v. 16, Nov. '46, p. 391-397.

Corrosion of ship hulls; effects of antifouling paints; types of anticorrosive compositions; anticorrosive pigments; paints for hot and cold application (including typical compositions); the various antifouling compounds. 17 ref. (To be continued.)

7-387. **Plastic Coating Inside Surface of Drill Pipe to Combat Corrosion Fatigue Failures.** L. E. Trishman. *Petroleum Engineer,* v. 18, Nov. '46, p. 194, 196, 198, 200.

Requirements for a satisfactory coating, and tests of many materials which resulted in selection of an air-drying and a thermosetting phenolic coating for experimental pipe string testing. Corrosion fatigue tests were carried out on these coatings using a rotating-beam machine.

7-388. **Aviation.** *Russian Technical Research News,* v. 1, no. 4, '46, p. 1.

Corrosion of valve heads is one of the major problems involved in increasing degree of supercharging and compression in airplane motors. Coating entire valve head

with a special alloy is recommended, containing 30% Cr, 65% Ni, small percentage of Si, Al, and Fe, and also minor amounts of Ca, Ce, and Th.

7-389. **Phosphate Coating of Aluminum.** R. C. Gibson and W. S. Russell. *Industrial and Engineering Chemistry (Industrial Edition),* v. 38, Dec. 7, '46, p. 1222-1227.

Process for producing a paint-holding phosphate coating on aluminum or its alloys from a solution containing zinc phosphate, nitrate and fluoborate. Applicable to zinc and steel, and their alloys. The coating is applied by spraying or immersion. Outdoor exposure, accelerated salt spray, humidity, and soak tests show good results. 11 ref.

7-390. **Studebaker Corporation Finishes 1947 Passenger Cars.** Bryant W. Pocock. *Products Finishing,* v. 11, Dec. '46, p. 26-28, 30, 32, 34, 36, 38, 40, 42.

Various stages of assemblies and the finishing operations involved in each. Paint testing procedures.

7-391. **Aluminum Can Be Electropolished.** *Products Finishing,* v. 11, Dec. '46, p. 56, 58.

The Battelle process, the Alzak process and the Brytal process. Aluminum reflecting surfaces produced by these three methods possess good corrosion and abrasion resistance, are resistant to fingermarking, and will withstand temperatures up to approximately 400° F. without crazing.

7-392. **Barrel Finishing of Metal Products. Part IV.** H. Leroy Beaver. *Products Finishing,* v. 11, Dec. '46, p. 64-66, 68, 70, 72, 74.

Points the way to a more effective use of soap that will give more satisfactory end results as well as provide for a saving in production costs.

7-393. **Wheels and Compounds for Buffing and Polishing.** John Hyler. *Steel,* v. 119, Dec. 16, '46, p. 92-93, 117.

Buffing wheels made of fabrics, felts and leathers; purposes for which they are best suited. (To be continued.)

7-394. **The Influence of Cobalt and Nickel in Vitreous Enamel Ground-Coats.** Gordon C. Priddey. *Foundry Trade Journal,* v. 80, Nov. 14, '46, p. 263-268, 271.

Theories which have been put forth to explain the effects of cobalt and nickel in improving adhesion. 21 ref.

7-395. **Mechanical Applications of Latex-Dip Coatings.** Fred W. Woerner. *Mechanical Engineering,* v. 68, Dec. '46, p. 1049-1052.

Characteristics of natural and synthetic rubber latices; porous articles; latex-dipped coatings; miscellaneous uses for latex; coating latex on metals. Special applications.

7-396. **Aluminum Cleaning Procedures.** Joseph S. Brady. *Iron Age,* v. 158, Dec. 19, '46, p. 76-79.

Behavior of various cleaning, oxidizing and deoxidizing materials and means of avoiding incomplete rinsing. Effect of surface preparation on welding operations. Practical procedures.

7-397. **Metal Spraying.** J. Barrington Stiles. *Welding,* v. 14, Nov. '46, p. 493-499.

Methods of preparation, the principles of the process, its operation, and some established applications.

7-398. **Supplementary Equipment for Buffing and Polishing. Part III.** John E. Hyler. *Steel,* v. 119, Dec. 23, '46, p. 62-63, 104.

Polishing wheels other than setup types, polishing lathes, and electric polishing motors. (To be continued.)

7-399. **Spray Welding.** *Steel,* v. 119, Dec. 23, '46, p. 74, 77.

Hard-facing process uses a powder-flame spray gun that produces a molecular or fusion bond between the sprayed, powdered alloy overlay and base metal.

SECTION VIII

ELECTROPLATING

8-1. **Throwing Power of Anodizing Baths.** Robert S. Herwig and Albert Leigh. *Iron Age,* v. 156, Dec. 20, '45, pp. 51-53.

Device described for visually determining, especially in the case of blind holes and crevices, corrosion protection afforded by anodizing baths. It also can be applied to measure throwing power of plating baths.

8-2. **Heavy Current Applications of Selenium Rectifiers for Tin Plating.** W. F. Bonner. *Products Finishing,* v. 10, Dec. '45, pp. 46, 48, 50.

Six rectifiers supplying the plating tanks, each capable of 540 kw. of plating power. Additional direct current is supplied by other rectifiers for electrolytic cleaning of the steel and for recovery of tin from the plating solutions. Rectifiers supply 7500 amperes at 12 volts, 5000 and 3000 amperes, also at 12 volts. All are of same general construction. Brief description of 7500-ampere equipment.

8-3. **Electricity for the Plater, Part V.** D. A. Cotton. *Products Finishing,* v. 10, Dec. '45, pp. 100-102, 104, 106.

Table gives values of current specified by 1937 and 1940 National Electric Codes for rubber insulated wire. Values are for copper of 98% conductivity and for one conductor in free air at room temperature of 86° F. Fourth and fifth columns have been added to show the circular mils allowed per ampere.

8-4. **Brass Plating for Rubber-to-Metal Adhesion.** *Steel,* v. 117, Dec. 24, '45, pp. 115, 118.

Conditions affecting application of process and methods for control reviewed. 4 ref.

8-5. **Porous Carbon Electrodes.** N. M. Winslow. *Electrochemical Society Preprint* 88-16, 1945, 14 pp.

Porous carbon in contact with both aqueous electrolyte and a body of immiscible liquid depolarizer is capable of acting simultaneously as an electrode and a wick carrying insoluble depolarizer to the active face. For reactions for which carbon is not a suitable electrode material, metal-coated porous carbon or graphite may be equivalent to a permeable metal electrode for utilization of insoluble liquid depolarizers.

8-6. **Chrome Plating Increases Life of Forge Dies.** *Engineers' Digest (American Edition),* v. 2, Nov. '45, p. 549.

Average life before plating was 15,000 forgings, increased to 35,000 by plating. Still better results obtained with dies for production of forged spanners and gas tongs. Thickness of chromium layer must not exceed 0.03 mm., as this would make it too brittle, particularly if temperatures of over 100° C. are reached and if thermal expansion of layer and base metal differ. (From *Z.d.V.D.I.*, Feb. '45, pp. 67-68.)

8-7. **Metals on Plastics.** H. Narcus. *Metal Industry,* v. 67, Nov. 23, '45, pp. 342-344.

Review of electrodeposition processes.

8-8. **Electrolytic Analysis of Strike Solutions.** R. A. Schaefer and J. B. Mohler. *Metal Finishing,* v. 43, Dec. '45, pp. 497-499, 503.

New cell and rapid method of determining approximate cathode current efficiency of silver strike baths developed. Cell easily reproducible. Cathode efficiency and the deplating time were directly proportional to silver cyanide concentration. Increasing bath temperature increased cathode efficiency. Appreciable quantities of various sodium and potassium salts can be present in silver strike solution without seriously affecting test cell results. Presence of colloids must be avoided as they give rise to errors amounting to as much as 50%.

8-9. **The Adhesion of Electrodeposits, III.** A. L. Ferguson and Elmer F. Stephan. *Monthly Review,* v. 32, Dec. '45, pp. 1237-1246.

Heating test; "black light" or "fluorescent" test; Erichsen cup test and variants; miscellaneous tests.

8-10. **Metals on Plastics.** H. Narcus. *Metal Industry,* v. 67, Dec. 7, '45, pp. 384-386.

Deals with "sensitizing" treatment and interpretation of results.

8-11. **Is a "Clean" Surface Necessary for Electroplating?** Ernest H. Lyons. *Steel,* v. 117, Dec. 31, '45, pp. 82, 92-93.

Classifies films according to their effects on electroplate.

8-12. **Hard Chromium Plating Directly on Carbon and Graphite.** Robert S. Herwig. *Materials & Methods,* v. 22, Dec. '45, pp. 1751-1753.

Technique developed for direct plating on carbon to increase fatigue life and other physical characteristics without destroying electric properties.

8-13. **German Synthetic Mechanical Goods—III.** *India Rubber World,* v. 113, Nov. '45, pp. 231-235.

Excellent rubber to metal adhesions because of method of brass plating. Details of method are given.

8-14. **The Electrodeposition of Metal on Plastics.** Harold Narcus. *Metallurgia,* v. 33, Dec. '45, pp. 107-108.

Chemical reduction method involves application to the plastic surface (after proper preparatory treatment) of a conductive and adherent bond coat by using a solution of ammoniacal silver nitrate or other easily reducible metallic salt and a suitable reducing agent (usually organic), followed by an intermediate layer of electrodeposited cop-

per or silver, and finally by a top layer of the desired metal such as chromium, zinc, iron, lead, nickel, gold, silver or cadmium. (From Electrochemical Society Preprint 88-5.)

8-15. **Electricity for the Plater. Part VI.** D. A. Cotton. *Products Finishing,* v. 10, Jan. '46, pp. 66-70.

Study of basic principle on which volt, ampere and watt operate, and some notes on instruments used for measuring them.

8-16. **Precision Seamless Tubing by Electrodeposition.** J. Albin. *Iron Age,* v. 157, Jan. 10, '46, pp. 54-58.

Accuracy of dimension and surface finish of intricate parts can be imparted to inside surfaces by United States Rubber Co.'s process of electroforming iron. Similar in external procedures to electroplating, through use of special electrolytes and controls, it is possible to create substantial homogeneous thicknesses of high quality iron in desired contours.

8-17. **Regenerative Plating, and Other Applications of Porous Diaphragms and Cells.** Myron B. Diggin. *Metal Finishing,* v. 44, Jan. '46, p. 8-12.

Regenerative plating; advantages of system.

8-18. **Protective Value of Electro-Tin as an Undercoating.** S. Wernick. *Metal Finishing,* v. 44, Jan. '46, p. 13-15.

Procedure; exposure tests.

8-19. **Deposition of Nickel-Cobalt Alloys From Chloride Solutions.** C. B. F. Young and Clifford Struyk. *Electrochemical Society Preprint* 89-1, 1946, p. 1-31.

Effects of solution temperature, solution concentration, metal ratios in solution, solution pH, cathode rotation, cathode current density, addition agents and superimposed alternating current, on the nickel-cobalt deposit. 22 ref.

8-20. **Pre-Polishing Cuts Plating Time 40%.** G. R. Makepeace. *American Machinist,* v. 90, Jan. 31, '46, p. 79-81.

Main landing gear piston on P-38 processed two hours faster when smooth finishing replaces rough grinding before chromium plating.

8-21. **Some Properties of Electrodeposited Copper-Lead Alloys.** Franz Bollenrath. *Monthly Review,* v. 33, Jan. '46, p. 18-23, 88.

Test bearings with electrolytic lead-bronze layers containing 8 to 12% lead have shown a compressive strength comparable to that of cast lead-bronze lined bearings. Some properties and the structure of such electrolytic lead-copper coatings are described. (Translation by H. J. Read of a report of the Institute for Industrial Material Research of the German Experimental Institution for Aeronautics.) 5 ref.

8-22. **Cadmium Whiskers.** *Monthly Review,* v. 33, Jan. '46, p. 28-30, 95.

Appearance; conditions of growth; properties.

8-23. **Plating Under Difficulties.** W. M. Phillips. *Monthly Review,* v. 33, Jan. '46, p. 33-34, 88.

Various wartime plating problems, such as chromium

plating of cylinders, gun barrels, landing gears; the difficulty of meeting specifications.

8-24. **The Adhesion of Electrodeposits, III. A. E. S. Research Project No. 3.** A. L. Ferguson and Elmer F. Stephan. *Monthly Review,* v. 33, Jan. '46, p. 45-46, 49-50, 53-54, 57, 60, 62-64.

Quantitative methods: Burgess method, influence of heating on adhesion; description of test by Ollard; variation of method by Faris; ring and plug test; Roehl modification of Ollard method; micro-adhesion modification of Ollard method.

8-25. **Chromate Passivation of Zinc.** S. G. Clarke and J. F. Andrew. *Metal Industry,* v. 68, Jan. 18, '46, p. 49-52.

Aging tests; behavior of film; humid atmosphere tests; salt spray test; notes on other tests. 2 ref.

8-26. **Electroplating Metal Sheets Prior to Fabrication.** E. A. Ollard. *Sheet Metal Industries,* v. 23, Jan. '46, p. 116-126.

Operating details for the production of electroplated sheet and strip for making pressings and stampings; advantages and drawbacks of fabricating this material.

8-27. **Practical Conductivity Measurements.** J. B. Mohler and Jean Sternisha. *Metal Finishing,* v. 44, Feb. '46, p. 58-62, 99-100.

Versatility and practicability of conductivity measurements; mathematical methods developed to illustrate how such measurements give approximate results expected. 4 ref.

8-28. **Tanks for Electroplating Solutions.** G. B. Hogaboom, Jr., and Nathaniel Hall. *Metal Finishing,* v. 44, Feb. '46, p. 63-66.

Some of the types of commercially available tanks are steel, wood, plastic and glass, ceramic; tank linings.

8-29. **Protective Value of Electro-Tin as an Undercoating.** S. Wernick. *Metal Finishing,* v. 44, Feb. '46, p. 67, 100.

Use of a tin undercoating for such finishes as zinc, cadmium, and to a lesser extent, nickel, is likely to be of some importance in the finishing of ferrous components, particularly those of complex shape, which are required to withstand difficult corroding conditions of service.

8-30. **Speculum Plating.** R. M. Angles, F. V. Jones, J. W. Price and J. W. Cuthbertson. *Metal Industry,* v. 68, Feb. 1, '46, p. 86-88.

Electrodeposition of tarnish-resisting copper-tin alloy. Study been made of the influence of various factors on the composition of the deposit and efficiency of deposition. (Paper presented to the Electrodepositors' Technical Society.) 5 ref.

8-31. **The Electrodeposition of Manganese.** H. Seymour. *Industrial Chemist,* v. 22, Jan. '46, p. 17-23.

Necessity for placing anodes outside the diaphragms has been eliminated by use of a lead-silver alloy for anode material. These anodes prevent oxidation and precipitation of manganese oxides, thereby making possible the redesign of the electrolytic cells. New cells have been designed to permit placing the anodes inside the diaphragms

and the cathodes outside the diaphragms. Flow of solution is to the one compartment common to all the cathodes, thence to the anode drilled in the cell and anode diaphragm frames; cites advantages.

8-32. **First Electrodeposition of Metal for Corrosion Resistance.** S. G. Bart. *Chemical Industries,* v. 58, Jan. '46, p. 51.

Formation of strongly adherent pore-free coatings by the electrodeposition of nickel on the inner surfaces of pipe and other vessels for the first time provides still another tool in the battle against corrosion losses.

8-33. **Bright Alloy Plating.** *Steel,* v. 118, Feb. 25, '46, p. 105, 108, 110.

Process for producing a ternary deposit of copper, tin and zinc. High protective value of deposit and other physical and chemical properties commend it to wider use. 3 ref.

8-34. **Chromium Plated Tools Have Longer Life.** Andrew A. Spisak. *American Machinist,* v. 90, Feb. 28, '46, p. 99-101.

Lundbye process that closely controls the thickness of plate. Table shows increase in tool life by plating.

8-35. **A Method for Measuring Effective Contact E.M.F. Between a Metal and a Semi-Conductor.** W. E. Stephens, B. Serin and W. E. Meyerhof. *Physical Review,* v. 69, Jan. 1 and 15, '46, p. 42-43.

By measuring zero bias resistance of such a rectifier as function of temperature, an effective contact e.m.f. may be calculated. This has been done for a few samples (silicon-tungsten) and a typical curve log R/T plotted against 1/T is shown.

8-36. **Preparing Aluminum for Electrodeposition.** Helmer Bengston. *Canadian Metals and Metallurgical Industries,* v. 9, Feb. '46, p. 24-28.

Bonding layers of zinc and aluminum oxide features of principal processes.

8-37. **Speculum Plating.** R. M. Angles, F. V. Jones, J. W. Price, and J. W. Cuthbertson. *Metal Industry,* v. 68, Feb. 15, '46, p. 126-128.

Electrodeposition of tarnish-resisting copper-tin alloy; composition of electrolyte; anode efficiency; stability bath. 2 ref.

8-38. **Silver Plating Aircraft Engine Bearings.** John S. Hart and C. E. Heussner. *Monthly Review,* v. 33, Feb. '46, p. 142-149.

Adhesion of silver to steel; properties of the deposits; plating to finish dimensions.

8-39. **Plating Rack Coatings.** L. A. Critchfield. *Monthly Review,* v. 33, Feb. '46, p. 152-157, 191.

Purpose of rack coatings; requirements; types; coating technique; important precautions.

8-40. **Bright Nickel Plating.** R. B. Saltonstall. *Monthly Review,* v. 33, Feb. '46, p. 162-165.

Early history; desired properties; requirements of the solution; requirements of the deposit; advantages of bright nickel.

8-41. **The Adhesion of Electrodeposits. Part IV. Correlated Abstract of Comments on Methods for Measuring the Degree of Adhesion.** *Monthly Review,* v. 33, Feb. '46, p. 166-167, 169-170, 173, 176-178, 180, 183-184, 187.

Bending and twisting tests; burnishing and buffing tests; impact tests; heating tests; "black light" or "fluorescent" test; Erichsen cup test and variants; scratch or scratch-and-knife test; chisel test.

8-42. **Manufacture of Copper Float Balls by Electrodeposition.** George B. Hogaboom. *Monthly Review,* v. 33, Feb. '46, p. 188.

Two methods suggested.

8-43. **Electroforming Microwave Components.** F. Hassell and F. Jenks. *Electronics,* v. 19, March '46, p. 134-138.

By using electroforming techniques, precision machining is done on the outside of a mandrel whose finish determines the surface condition inside the completed piece. Process of electrodeposition of metal on the mandrel builds up a heavy coating of the material which is essentially free from stress. Such a condition helps to maintain the dimensional accuracy of the piece over long periods of time, as well as to allow machining without producing distortion.

8-44. **Throwing Power.** R. S. Herwig and A. Leigh. *Metal Industry,* v. 68, March 1, '46, p. 166-167.

Device for visually determining, especially in the case of blind holes and crevices, the corrosion protection afforded by anodizing baths. Can also be applied to measure the throwing power of plating baths. 2 ref.

8-45. **Speculum Plating.** R. M. Angles, F. V. Jones, J. W. Price and J. W. Cuthbertson. *Metal Industry,* v. 68, March 1, '46, p. 167-168.

Electrodeposition of tarnish-resisting copper-tin alloy. 4 ref.

8-46. **Corrosion Resistant Plastic Coating.** *Steel,* v. 118, March 11, '46, p. 114, 144.

Coating for plating equipment is a combination of resistant vinyl resins, pigments, and plasticizers and combines many of the properties of molded plastic products; is applied cold, and requires no force drying or baking; is unaffected by water, and does not stain by contact with plating chemicals. Many washings with hot alkaline cleaners do not change the appearance of the coating.

8-47. **The Electrodeposition of Copper.** Herbert Bandes. *Metal Finishing,* v. 44, March '46, p. 110-115.

Review of recent literature; dependence of the metallurgical nature of the electrodeposited copper with respect to the following factors: *(a)* solution composition; *(b)* current density; *(c)* temperature; *(d)* agitation; *(e)* addition agents. 76 ref.

8-48. **Electroplating and the Motor Industry.** H. Silman. Preprint, *Journal of the Electrodepositors' Technical Society,* v. 21, 1946, p. 65-78.

Place of electroplated components in car manufacture with special reference to user requirements and the diffi-

culties of meeting them. The chief metals deposited on car components are nickel, chromium, cadmium, zinc, tin, silver, and to a lesser extent lead and copper. Other metals are being used to a limited extent for special purposes, e.g., rhodium and speculum alloy.

8-49. **Chromium Plating on Copper, Nickel and Steel.** *Steel,* v. 118, March 18, '46, p. 123-124.

Discussion of procedure and results of an investigation of surface preparation. (From Electrochemical Society Preprint 88-28.)

8-50. **Electricity for the Plater, Part VIII.** D. A. Cotton. *Products Finishing,* v. 10, March '46, p. 40-42, 44, 46, 48.

Discusses Faraday's laws.

8-51. **Lead-Tin Alloy Plating.** A. E. Carlson and J. M. Kane. *Monthly Review,* v. 33, March '46, p. 255-261.

Newly developed information on methods of plating lead-tin alloys containing any desired amount of tin from 5 to 60%. Details are given for the use of separate lead and tin anodes in the deposition of low-tin, high-lead alloys, and for the use of alloy anodes. Necessary modifications for the successful plating of bearings; some typical applications of lead-tin alloy coatings.

8-52. **Electroplating Upon Aluminum.** Walter R. Meyer. *Monthly Review,* v. 33, March '46, p. 269-270, 273-274, 277.

Applications; methods of plating aluminum; preparatory steps; plating upon the zinc film.

8-53. **Surfaces for Electroplating.** Ernest H. Lyons, Jr. *Canadian Metals and Metallurgical Industries,* v. 9, March '46, p. 27-29, 46.

Plating on filmed surfaces; classification of surface films; examples. (Contribution to symposium of the Electrochemical Society on "Before and After Plating", 1945.) 16 ref.

8-54. **The Adhesion of Electrodeposits, IV.** A. L. Ferguson. *Monthly Review,* v. 33, March '46, p. 279-280, 283-284, 286-287, 289, 292, 295-296, 299.

Grinding wheel test; cathodic or electrolytic test; X-ray test; can opener test; Jacquet test; explosion test; B.N.F. impact test; Ollard test; micro-adhesion test; solder or adhesive test; suggested experimental work.

8-55. **Plating Aluminum.** Helmer Bengston. *Metal Industry,* v. 68, March 15, '46, p. 206-208.

Describes use of an intermediate, chemically applied coating of zinc, and an intermediate, electrochemically formed aluminum-oxide coating. Anodic coating is partially removed by chemical treatment to render it receptive to electroplating or can be modified by use of a phosphoric acid electrolyte. (Paper presented before the Electrochemical Society.)

8-56. **Electroplating of Aluminum.** Gilbert C. Close. *Light Metal Age,* v. 4, March '46, p. 8-9, 13, 17.

Scope, limitations and methods of application of the "Krome-Alume" process of electroplating aluminum. Process involves precleaning, anodizing, modification of the

anodic coating and plating. Modification is the critical phase and may be accomplished in any one of a number of alkaline or acid solutions; one that has proved very successful is hydrofluoric acid.

8-57. **Electricity for the Plater. Part IX.** D. A. Cotton. *Product Engineering,* v. 10, April '46, p. 66-68, 70, 72, 74.

Electrical principles underlying processes of electrodeposition.

8-58. **Indium Plating Aids Drawing of Aluminum Alloys.** E. E. Halls. *Metallurgia,* v. 33, March '46, p. 243-245.

Investigations have shown that an electroplated coating of indium has lubricative properties and helps considerably in the drawing of aluminum alloys. Refers to electrodeposition of indium as practiced commercially in America.

8-59. **Plating Die Castings.** E. A. Ollard and E. B. Smith. *Metal Industry,* v. 68, April 12, '46, p. 286-288.

Chromium-plating zinc-base die castings. Nickel-plating process, which is preparatory to the final chromium cover. Various processes for doing this compared; detailed measures necessary to achieve a perfect plate.

8-60. **Speculum for Brightness.** Fred P. Peters. *Scientific American,* v. 174, May '46, p. 207-209.

Electrodeposited coatings of speculum—an alloy of copper and tin—give good tarnish and wear resistance. Speculum is less expensive to apply than silver or chromium plating and cuts labor requirements considerably. Future applications will cover a broad range.

8-61. **Electroplating on Aluminum.** *Steel,* v. 118, May 6, '46, p. 142-144, 146, 148.

Two general and one special procedure for preparing aluminum for electroplating.

8-62. **Plating Die Castings. Part 3.** E. A. Ollard and E. B. Smith. *Metal Industry,* v. 68, April 26, '46, p. 325-328.

A method by which cobalt may be added to the nickel bath. Control of the nickel solution and detection, estimation and removal of impurities such as iron, copper, and organic matter.

8-63. **Copper-Tin Alloy Plating.** Clifford Struyk. *Monthly Review,* v. 33, April '46, p. 394-398.

Experiences with true bronze plating for stop-off against nitriding; suggests peacetime uses of electrodeposited bronze coating for decorative purposes.

8-64. **Health Hazards in Electroplating.** William Blum. *Monthly Review,* v. 33, April '46, p. 411-414.

Poisonous liquids and sprays; irritants.

8-65. **Methods of Preparation of Aluminum for Electrodeposition.** Helmer Bengston. *Metal Finishing,* v. 44, May '46, p. 202-206, 232.

Zinc immersion plating procedure; anodic coating as a base for electroplating upon aluminum alloys; zinc-plating aluminum; preparation of aluminum for cyanide zinc plating.

8-66. **Diffused Nickel-Zinc Coatings.** George Black. *Metal Finishing,* v. 44, May '46, p. 207, 209.

Corronizing process using nickel-zinc coating offers superior protection and is especially useful where severe corrosive conditions resulting from moisture, fumes, brines, and heat are encountered.

8-67. **Electricity for the Plater.** D. A. Cotton. *Products Finishing,* v. 10, May '46, p. 76-78, 80, 82.

Various sources of power supply for electroplating.

8-68. **Production Plating of Zinc Die Casting.** Herbert Chase. *Iron Age,* v. 157, May 30, '46, p. 34-38.

Bright copper-nickel-chromium plating of zinc die castings on a high-production basis at the plant of the Electric Auto-Lite Co. Solutions, current densities and conveying arrangements.

8-69. **The Significance of Water in the Plating Room.** Zachary Irenas. *Metal Finishing,* v. 4, May '46, p. 195-197.

Importance of using purified water for plating baths.

8-70. **Porous Chromium Plating Adds to Piston Ring Life.** Tracy C. Jarrett and Robert D. Guerke. *Materials & Methods,* v. 23, May '46, p. 1293-1297.

Exhaustive tests show plated rings give about five times the ring life and 50 to 80% less cylinder wear than similar types of unplated rings.

8-71. **Plating Die Castings.** E. A. Ollard and E. B. Smith. *Metal Industry,* v. 68, May 10, '46, p. 366-368.

Methods now in use for applying the final chromium cover on the zinc-base die casting, now prepared for this process by means of a copper coating, followed by a nickel plate. Silver, speculum and bronze finishes are also discussed.

8-72. **The Transference Number of Nickel in a Nickel Sulphate Solution.** C. J. B. Zitek and H. J. McDonald. *Electrochemical Society Preprint* 89-24, April 15, '46, p. 279-287.

The nickel transference number in a 0.1*N* $NiSO_4$ solution was determined by the gravimetric (Hittorf) method, using a modified Findlay's cell. Various combinations of electrodes were experimented with under different conditions until a combination was found under which the amount of hydrogen evolved was practically zero. The arrival at the actual nickel transference number, under 100% plating efficiency, involved plotting a series of determinations having various small amounts of hydrogen evolved and extrapolating the value to a point of zero hydrogen evolution. The experiments were conducted at 40 $\pm$ 0.1° C and the nickel transference number at this temperature was found to be 0.366.

8-73. **Symposium on Nickel Plating.** V. Mattacotti, W. M. Phillips, B. Martin, M. B. Diggin, W. A. Wesley, W. C. Pinner. *Monthly Review,* v. 33, May '46, p. 494-510, 526.

Cold nickel plating and soft deposits; Watts type nickel baths; organic type bright nickel baths; alloy type nickel baths; all-chloride nickel baths; high-speed nickel baths.

8-74. **Silvering of Plastics.** Harold Narcus. *Metal Finishing,* v. 44, June '46, p. 240-242.

Practical procedures for commercial production of electrodeposited coatings on plastics to meet new demands in electrical and electronic equipment fields. Costume jewelry an established application of the process. 16 ref.

8-75. **Common Plating Bath Troubles.** H. J. Sedusky and J. B. Mohler. *Metal Finishing,* v. 44, June '46, p. 243-247.

General bath troubles; brass; cyanide cadmium; chromium; acid copper; rochelle copper. 15 ref.

8-76. **Chromium Plating Practice in the Facing of Press Dies.** E. A. Ollard and E. B. Smith. *Sheet Metal Industries,* v. 23, June '46, p. 1129-1141, 1159.

Besides being extremely hard, chromium has a low coefficient of friction and dies faced with this material give a much longer life than steel dies of the same hardness figure. Its corrosion resistance is also advantageous. Processes necessary for plating a thick, adhesive layer of chromium onto steel dies are described in full.

8-77. **The Purification of Electroplating Solutions.** Myron B. Diggin. *Monthly Review,* v. 33, May '46, p. 513-526.

Classification and sources of impurities; detection of impurities; classification of removal methods; effects of impurities in various solutions and their removal; cadmium cyanide solutions; chromium solutions; copper cyanide solutions; nickel plating solutions; continuous purification of bright nickel solutions. References.

8-78. **Electroplating in the U. S. A.—Some Impressions of a Recent Visit.** A. W. Hothersall. *Metal Industry,* v. 68, June 7, '46, p. 456-458.

Trends in U. S. Specifications for nickel on steel and for nickel on brass and zinc. Chromium plating; copper plating; plating on aluminum.

8-79. **Electricity for the Plater. Part XI.** D. A. Cotton. *Products Finishing,* v. 10, June '46, p. 66-68, 70, 72, 74, 76, 78.

Discussion of various sources of power supply for electroplating; motor generator sets, rectifiers.

8-80. **Determination of the Thickness of Chromium Deposits on Nickel by the Drop Test.** E. S. Spencer-Timms. *Journal of the Electrodepositors' Technical Society (Preprint),* v. 21, 1946, p. 79-90.

Method in which a drop of acid is placed on the surface and the time taken to dissolve the coating is measured.

8-81. **Procedures for Nickel Plating on Zinc Die Castings.** E. J. Roehl. *Die Casting,* v. 4, July '46, p. 70-76.

A. S. T. M. specifications; casting design and specification; surface preparation; preparation and plating of zinc-base die castings.

8-82. **Bright Dipping.** Gustaf Soderberg. *Metal Industry,* v. 68, June 21, '46, p. 492-494.

Existing bright dipping processes for copper and its alloys, cadmium plate and zinc plate, magnesium and lead are reviewed. Applications of the processes are listed and discussed and a theory of bright dipping similar to that for anodic brightening is proposed. (Paper for Electrochemical Society.)

8-83. **Technical Advances in Electroplating.** Allen G. Gray. *Steel,* v. 119, July 8, '46, p. 102-108.

Speakers at American Electroplaters' Society meeting reveal new developments in electrotinning, electropolishing, adhesion, surface preparation and organic coatings. Weirton men report on engineering details of plating wide strip at high speed. Timby of Jones & Laughlin discusses alkaline baths.

8-84. **Electroplating During the War—I.** E. A. Ollard and E. B. Smith. *Chemical Age,* v. 54, June 8, '46, p. 633-638.

Protection of steel parts; barrel plating; tropical requirements; cartridge cases; building up machine parts; lubrication of surfaces; indium infusion; tin-plating.

8-85. **Thirty-Third Annual Convention of the A. E. S. Held at Pittsburgh.** George B. Hogaboom. *Metal Finishing,* v. 44, July '46, p. 280-287, 302.

Notes on the meeting and abstracts of some of the papers read.

8-86. **Developments in Silver Plating; A Review of Recent Trends.** Philip J. Lo Presti. *Metal Finishing,* v. 44, July '46, p. 288-290.

Variables occurring in the silver plating solution are: components of the solution; impurities; temperature of solution; degree of agitation.

8-87. **Common Plating Bath Troubles. Part II.** H. J. Sedusky and J. B. Mohler. *Metal Finishing,* v. 44, July '46, p. 293-296.

High-efficiency sodium cyanide copper; high-efficiency potassium copper cyanide; cyanide gold; acid lead; cyanide silver; alkaline tin; acid zinc; cyanide zinc; nickel.

8-88. **Electroplating During the War—II.** E. A. Ollard and E. B. Smith. *Chemical Age,* v. 54, June 15, '46, p. 664-667.

Electrodeposition for stopping-off; anodizing; plating with precious metals; pickling of bullets.

8-89. **Improved Chromium Plate.** A. L. Peach. *Metal Industry,* v. 69, July 5, '46, p. 14-16.

A method which considerably improves the resistance of hard chromium to the effects of distortion and impact and somewhat increases the field in which thicker deposits may be used. Method is one in which two chromium baths are used to provide a composite deposit comprising a "soft" adherent and impact-absorbing underlayer and a very hard wear resisting outer layer. Observations restricted to ferrous metals only.

8-90. **Precision Metal Parts Produced by Electroforming.** H. R. Clauser. *Materials & Methods,* v. 24, July '46, p. 112-116.

Development of the process; electroforming technique; materials that can be electroformed; characteristics, advantages, limitations; uses and applications.

8-91. **Distribution of Current Along a Cylindrical Anode Inside of a Concentric Tube.** Arnold Weisselberg and Staff. *Electrochemical Society Preprint* 90-1, '46, 8 p.

On the basis of actual metal deposits applied to an anode rod centrically suspended in a cylindrical cathode, mathematical equations are developed for calculating voltage and current distribution along the cylindrical anode.

8-92. **Routine Control of Brass Plating Processes.** H. E. Zentler Gordon and Eric R. Roberts. *Electrochemical Society Preprint* 90-2, '46, 22 p.

The fact that satisfactory bonding between rubber and brass depends on both the composition and the structure of the latter necessitates a rigid control of the electroplating process. Rapid and accurate analyses of the plating solutions and of the deposits are essential, the effectiveness of the control depending ultimately on the time which elapses between taking samples and making adjustments to the bath. In order to decrease this time to the maximum, the available methods of analysis have been subjected to careful examination and, where possible, micropolarographic methods have been introduced.

8-93. **Electrogalvanizing. The Tainton Process for Brylanized Wire.** H. Roebuck and A. Brierley. *Metal Industry*, v. 69, July 19, '46, p. 50-53.

Essentially the Tainton electrogalvanizing process is an adaptation of the Tainton high-acid, high current density process for making electrolytic zinc, but where the zinc has to be deposited onto steel wire, an even higher current density is necessary. Control of many intricate technical details insures a high-grade product. (Paper for Electrodepositors Technical Society.)

8-94. **The Treatment of Steel Strip Prior to Fabrication.** W. F. Coxon. *Sheet Metal Industries*, v. 23, July '46, p. 1307-1310.

German practice; advantages of using preplated strip; disadvantages and remedies; other pretreatment processes; polishing; continuous plating of strip; electrotinning; lacquered steel strip.

8-95. **Analysis of Electroplating "Strike" Solutions.** *Steel*, v. 119, Aug. 5, '46, p. 124-125, 141, 144.

Low efficiency strike solution is important for adherence of electroplates, particularly on steel products. New method of routine production control is described.

8-96. **Determination of Impurities in Electroplating Solutions. Part I. Introduction.** *Monthly Review*, v. 33, Aug. '46, p. 836-837, 840-842.

Discussion of colorimetry; general information; analysis of nickel plating baths for metallic impurities. (Work being carried out on American Electroplaters' Society Research Project no. 2.)

8-97. **Job Plating in Volume.** Herbert Chase. *Steel*, v. 119, Aug. 19, '46, p. 102-108.

Use of holding fixtures wherever possible for buffing and polishing and conveyerized setups for buffing and plating reduces costs and speeds production without sacrificing quality.

8-98. **Economics of Electroplating.** T. F. O'Connor. *Metal Industry,* v. 69, Aug. 2, '46, p. 97-100.

Optimum current density for mass production. Use of the mathematical equation which gives the equilibrium point, in terms within the scope of the average electroplater.

8-99. **The Adhesion of Electrodeposits. IV. Correlated Abstract of Comments on Methods for Measuring the Degree of Adhesion. A. E. S. Research Project No. 3. (Continued.)** *Monthly Review,* v. 33, June '46, p. 620-629, 632-635.

Supersonic test; black light test; whirl test; chisel test; roll test; shot impingement test; other tests.

8-100. **Abstracts of Papers Presented at the 33rd Annual Convention.** *Monthly Review,* v. 33, July '46 p. 707-711, 745.

Wartime activities on plating at the National Bureau of Standards; nickel plating on steel by chemical reduction; purification of rhodium plating baths; Corronizing wire screen cloth using radiant heating; X-ray diffraction studies of electrodeposits; anodizing and dye coloring magnesium alloys; periodic chart for electroplaters; plating with acid copper solution; review of developments in electroplating in Great Britain during the war; disposing of plating room waste liquors in compliance with stream pollution laws; effect of surface preparation on the durability of organic coatings; resins of the vinyl family in metal finishing; examination of electrocleaned steel by the electron diffraction technique.

8-101. **Plating of Zinc-Base Die Castings.** D. M. Overcash. *Monthly Review,* v. 33, July '46, p. 714-717, 735.

Casting quality; racking; processing cycle.

8-102. **Electroplating of Aluminum and Its Alloys.** Mitchell Raskin. *Metal Finishing,* v. 44, Aug. '46, p. 337-339.

Zinc immersion process solves problem of oxide removal and surface etching by replacing the oxide film with an adherent metallic coating. Any metal that can be successfully plated upon zinc can then be used directly on the zinc-coated aluminum.

8-103. **Nickel Plating on Steel by Chemical Reduction.** Abner Brenner and Grace E. Riddell. *Journal of Research of the National Bureau of Standards,* v. 37, July '46, p. 31-34.

Process has been developed for the production of adherent nickel deposits of good quality on steel without the use of an electric current. Deposition of nickel is brought about by chemical reduction of a nickel salt with hypophosphites in a hot ammoniacal solution. Reaction is catalytic and no reduction occurs in the solution unless certain metals are introduced into the bath. The reduction then occurs only at the surface of the immersed metal.

8-104. **Economics of Electroplating. (Concluded.)** T. F. O'Connor. *Metal Industry,* v. 69, Aug. 16, '46, p. 140-142.

Optimum current density for mass production.

8-105. **Hard Chrome Plating Aids Aircraft Production.** Gilbert C. Close. *Modern Machine Shop,* v. 19, Sept. '46, p. 158-160, 162, 164, 168, 170, 172, 174, 176, 178, 180.

Outline of the technique used at Douglas Aircraft in chromium plating to resist wear and to build up undersize parts.

8-106. **Copper Plating From Fluoborate Solutions.** Clifford Struyk and A. E. Carlson. *Monthly Review,* v. 33, Sept. '46, p. 923-934.

Results of an extensive investigation of the copper fluoborate plating electrolyte and its operating characteristics. Data include preferred bath compositions, effect of bath constituents and additions on limiting cathode current densities and resistivity at several temperatures, current efficiencies, and anode performance, as well as hardness and tensile data on heavy copper deposits. Comparison of the fluoborate with the sulphate type of bath shows in a striking manner the high-speed plating characteristics of the former type, which offers great promise in applications requiring heavy copper deposits. Rapid plating of moderate thicknesses of copper as an undercoat for nickel and chromium is also an attractive possibility.

8-107. **Silver Plating Bearings.** F. C. Mesle. *Monthly Review,* v. 33, Sept. '46, p. 937-942.

Why use silver; specifications; selective plating; adhesion; preparation of the steel surface for plating; control of thickness of the silver deposit; deposition of heavy silver deposits.

8-108. **Plating Bath Characteristics.** H. J. Sedusky and J. B. Mohler. *Metal Finishing,* v. 44, Sept. '46, p. 374-381.

Current density; bath voltage; electrode efficiency; polarization; covering power; throwing power; metal distribution; plating range. 10 ref.

8-109. **Gas-Fired Immersion Heaters Speed up Plating Production.** *Metal Finishing,* v. 44, Sept. '46, p. 382-383.

Brief details of equipment and operation at Chemical Plating Co.

8-110. **Surface Finishes for Aluminum.** J. F. Mason. *Iron Age,* v. 158, Sept. 12, '46, p. 66-68.

Methods of applying a wide variety of metals to aluminum and its alloys by electroplating. Composition of the plating baths, times, and temperatures are given, together with pertinent information on cleaning, pretreatment and post treatment.

8-111. **Health Hazards in the Electroplating Industry.** L. B. Bourne. *Journal of the Electrodepositors' Technical Society,* v. 21, '46, p. 121-128 (Reprint).

Recommends adequate ventilation maintained in good repair and in continuous use. Automatic machinery for feeding, dipping and drying. Cleanliness of the department. Protective clothing, boots, gloves, respirators, should be provided and used, kept clean, and stored carefully when not in use. Efficient barrier creams properly used are essential, and washing facilities in the plating department should be of the latest type with hot and cold running water, good toilet soap, and an adequate supply of towels.

8-112. **Plating Auto Hardware.** Herbert Chase. *Iron Age,* v. 158, Sept. 19, '46, p. 59-61.

Production plating of automobile hardware in a fully conveyerized setup in Ternstedt plant of General Motors Corp. Racking procedure, solutions and current density for copper cyanide strikes, bright nickel plate, bright copper and chromium plate and various rinses.

8-113. **Nickel-Zinc Corronizing.** L. C. Conradi. *Corrosion and Material Protection,* v. 3, Aug-Sept. '46, p. 12-13.

Primary field of application for nickel-zinc Corronizing is where severe corrosion conditions resulting from SO_2 and SO_3 gases in combination with moisture, water and heat must be combated. Automobile exhaust mufflers, fuel tanks, burner parts, flue pipes, ventilating ducts and coal hoppers are all good applications. Where corrosive conditions due to salt spray and brine must be met, nickel-zinc Corronizing gives good account of itself. Can be applied to sheet metal subsequently fabricated into metal parts or applied to completely fabricated article.

8-114. **Nickel-Zinc and Nickel-Tin Corrosion Resistant Metal Coatings.** L. C. Conradi. *Product Engineering,* v. 17, Sept. '46, p. 127-129.

Double plated metals subsequently heat treated to improve corrosion resistance. Plating materials, suitable thicknesses of plating and relative cost; typical data on effectiveness of Corronizing from salt spray tests; information for use in design.

8-115. **Codeposition of Tungsten and Nickel From an Aqueous Ammoniacal Citrate Bath.** Luther E. Vaaler and M. L. Holt. *Electrochemical Society Preprint* 90-9, '46, 12 p.

A new aqueous plating bath for the electrodeposition of tungsten-nickel alloys is described. Bath contains sodium tungstate, citric acid, nickel sulphate and ammonium hydroxide. When this type of bath was operated at various bath concentrations and conditions of electrolysis, it was found to yield cathode deposits containing from 10 to 35% tungsten.

8-116. **Electroplating of Aluminum. Part I.** *Light Metals,* v. 9, Sept. '46, p. 461-466, 467-473.

Practical value of the electroplating of aluminum and its alloys, with special reference to silver plating and soft soldering. The Alumon process of preparation and the so-called Krome Alume plating process are considered in detail.

8-117. **New Plating Installation Features Gas-Fired Immersion Heaters.** Arthur Q. Smith. *Products Finishing,* v. 10, Sept. '46, p. 34-36, 38, 40.

Atmospheric immersion burners have a rated input of 400,000 B.t.u. each. In former shop, company had a four-barrel plating unit with which it was able to turn out about 1700 lb. per day. In new plant with only a three-barrel automatic unit and the gas-fired immersion heaters on the cleaning and washing tanks, firm has been able to step up production to 2500 lb. per day.

8-118. **Electroplating on Aluminum. Part I.** *Metal Industry,* v. 69, Sept. 13, '46, p. 224-226.

Details of cleaning, surface preparation, and coating deposition. Includes several useful tables.

8-119. **Identification of Electroplated Coatings.** *Materials & Methods,* v. 24, Sept. '46, p. 673.

Procedures presented in form of handy table. Five tests for each of eleven coatings are: color, appearance, scratch test for hardness, spot tests with acids, and chemical identification tests.

8-120. **Electroplating on Aluminum. (Concluded.)** E. G. West. *Metal Industry,* v. 69, Sept. 27, '46, p. 264-266, 268.

Cleaning, surface preparation, coating deposition.

8-121. **Properties of the Plate.** H. J. Sedusky and J. B. Mohler. *Metal Finishing,* v. 44, Oct. '46, p. 420-422, 428.

Wear and corrosion resistance, ductility and crystalline structure; effects of heat treatment on plated parts; physical properties of electrodeposited materials. 12 ref. (To be continued.)

8-122 **Bibliography of Electrodeposited Nickel Alloys.** Myron B. Diggin and Otto Kardos. *Metal Finishing,* v. 44, Oct. '46, p. 429-432.

Patents, articles and books relative to nickel alloy deposition are listed. Brief notes on each item are given.

8-123. **Recent Developments in the Use of Electrolytic Tin-Plate and Phosphated Black Plate.** W. G. Cass. *Sheet Metal Industries,* v. 23, Oct. '46, p. 1917-1918.

Some recent German work on tin-plate substitutes in food canning. Some of the latest results obtained in the U.S.A. with electrolytic tin-plate.

8-124. **A Record of Effort and Achievement in the Electroplating Industry.** A. F. Brockington. *Sheet Metal Industries,* v. 23, Oct. '46, p. 1969-1971, 1974.

Specialized types of equipment; applications of protective metal coatings to war material, in particular the electrodeposition of hard chromium, nickel, and anti-corrosion finishes such as zinc and cadmium.

8-125. **Electroplating of Aluminum. (Concluded.)** *Light Metals,* v. 9, Oct. '46, p. 529-535.

Continues discussion on the sodium zincate treatment and considers other processes, especially with reference to plating for soft soldering.

8-126. **Report of a Discussion at a Joint Meeting of the Electrodepositors' Technical Society and the Institution of Electrical Engineers.** *Journal of Electrodepositors' Technical Society,* v. 21, 1946, p. 129-148. (Reprint.)

Condensation and discussion of two papers on electrotinning: "Continuous Electrotinning of Steel Strip in the Manufacture of Tinplate", by F. Frenkel, and "Electrical Equipment for Continuous Strip Electrotinning Lines", by P. F. Grove. First paper describes essential features of electrotinning process and plant soon to be in operation in Britain, based on American design. Gives extensive details and photographs of "Ferrostan" process developed by Carnegie-Illinois Steel Corp. Second paper describes the electrical equipment used in the process.

8-127. **Alloy Type Nickel Baths.** M. B. Diggin. *Metal Industry,* v. 10, Oct. 11, '46, p. 302-303.

Bright plating with cobalt-nickel. Process is based on Weisberg-Stoddard patents.

8-128. **Measurement of Embrittlement During Chromium and Cadmium Electroplating and the Nature of Recovery of Plated Articles.** Carl A. Zapffe and M. Eleanor Haslem. *American Society for Metals Preprint,* no. 29, 1946, 20 p.

Embrittlement resulting from electroplating, specifically the chromium plating of 17% chromium, 1% carbon stainless steel wire in the annealed and in the cold drawn conditions. Curves show the course of embrittlement with increasing plating time, and the remarkable comparison of chromium plating and cadmium plating with one another and with straight hydrogen plating as hydrogenizers of steel. Some tests preliminary to a subsequent research are presented which show marked differences in the rates of recovery when plated specimens are aged in different mediums, such as water, oil, a caustic solution, and dry argon, at the same temperature. For articles heavily plated with chromium, temperature is investigated as a variable in the recovery of ductility.

8-129. **Research Concerning Electrolytical Deposition of Metals.** R. Piontelli, M. Runza, and M. Minoja. *Engineers' Digest,* v. 3, Oct. '46, p. 525. (From *La Metallurgia Italiana,* v. 38, no. 1-3, Jan-March '46, p. 15-22.)

A general characteristic was found to be the tendency of superficial striations to favor the separation of crystal nuclei. Another interesting result was that an oxidized aluminum surface when used as cathode in the electrodeposition of lead caused the localized separation of very few nuclei.

8-130. **Hard Chromium Plate and Its Uses.** J. M. Hosdowich. *Materials & Methods,* v. 24, Oct. '46, p. 896-900.

Magnified cross section shows the difference between decorative chromium plate and hard chromium plate; comparative hardness of metals; comparative static friction of various metal surfaces given in scales. Discusses characteristics and many uses.

8-131. **Horizontal Plating Barrels and Auxiliary Equipment.** William H. Jackson. *Monthly Review,* v. 33, Nov. '46, p. 1162-1173.

All equipment used in preliminary and subsequent treatment of articles for plating.

8-132. **Adherent and Dense Heavy Silver Deposits.** Ralph A. Schaefer. *Monthly Review,* v. 33, Nov. '46, p. 1176-1178.

Electrocleaning, silver striking, silver plating, and annealing, as applied to the silver-plated bearing with triplex construction. 12 ref.

8-133. **Properties of the Plate. (Conclusion.)** H. J. Sedusky and J. B. Mohler. *Metal Finishing,* v. 44, Nov. '46, p. 476-478.

Physical properties; tensile strength; hardness; wear; ductility; adhesion; thickness; corrosion resistance; and porosity.

8-134. **Silver Plating Bearings.** F. C. Mesle. *Monthly Review,* v. 33, Oct. '46, p. 1056-1065.

Uniform, fine-grained structure of the silver deposit; physical properties of silver deposits; nodules; inclusions; visible porosity.

8-135. **Polishing and Plating Oldsmobile Three-Piece Bumpers.** Charles O. Herb. *Machinery,* v. 53, Nov. '46, p. 158-165.
Straightline continuous production carrying bumpers on conveyers from preliminary washing and degreasing through multiple stages of polishing, copper plating, nickel plating and chromium plating.

8-136. **Deposition of Metal on Plastics.** E. A. Ollard and E. B. Smith. *Plastics (London),* v. 10, Oct. '46, p. 527-530, 551.
Preliminary treatment and sensitizing; silver by reduction; reducing solutions; techniques of silvering; temperature considerations; spraying method; method of suspension in the plating solution. (To be continued.)

8-137. **The Plating of Plastics.** *British Plastics,* v. 18, Oct. '46, p. 428-432.
A brief review of the application of electroplating to plastics materials.

8-138. **Electroplating, Polishing and Buffing at the U. S. Naval Gun Factory, Washington, D. C.** Albert L. Fry. *Metal Finishing,* v. 44, Nov. '46, p. 467-471, 478.
Plating gun barrels; finishing equipment; finishing work; plating preparation; plating solutions; cadmium strip.

8-139. **Chevrolet's New Setup for Plating Bumpers.** *Automotive and Aviation Industries,* v. 95, Nov. 1, '46, p. 18-21.
New electroplating department recently placed in operation produces a nickel coating of 0.0015 in., resulting from a cycle of 1½ hr. duration in the nickel plating unit. Describes and illustrates complete sequence of operation from blanking and forming to final chromium plate.

8-140. **Cadmium Plate and Passivated Cadmium-Plate Coatings.** E. E. Halls. *Metallurgia,* v. 34, Oct. '46, p. 295-297.
Results of tests indicate a method of processing which will give satisfactory performance. Test pieces of mild steel and of brass and copper were used.

8-141. **Reducing Embrittlement in Electroplating.** C. T. Eakin and H. W. Lownie, Jr. *Iron Age,* v. 158, Nov. 21, '46, p. 69-72.
Procedures, substantiated by several years of production application, whereby embrittlement can be minimized during the plating operation and removed by heat treatment following plating. A nonacid method for deplating is also presented.

8-142. **Immersion Heaters Speed up Plating Production.** Arthur Q. Smith. *Industrial Gas,* v. 25, Nov. '46, p. 23-24, 36-37.
Illustrated article describes techniques used by Chemical Plating Co., Stratford, Conn. Gas-fired units are used.

8-143. **Metal Surfacing by Hard Chromium Plating.** Edwin H. Halvorsen. *Tool Engineer,* v. 17, Nov. '46, p. 35-40.
Decorative chromium plating; hard chromium plate; other methods of surfacing and other alloys in use today;

chromium plated high speed steel tools; surface finish important; tests on gear shaper cutters; misconceptions of chromium surfacing.

8-144. **Some Impressions of Electroplating in the U. S. A.** A. W. Hothersall. *Journal Electrodepositors' Technical Society,* v. 21, '46, p. 171-180. (Reprint.)

Some impressions of American developments such as specifications and bright nickel plating, and some examples in which American practice is different from the British.

8-145. **Electroplating on Aluminum.** E. G. West. *Journal Electrodepositors' Technical Society,* v. 21, '46, p. 211-226. (Reprint.)

Problems in depositing other metals on aluminum-base materials; principles of the methods used; cleaning; surface roughening by etching; etching combined with an immersion deposit; Zinc immersion process; copper immersion process; preplate anodizing; anodizing followed by direct plating; polishing; loading the work; testing.

8-146. **Some New Aspects of the Protection of Steel by Tin and Tin Alloy Coatings.** E. S. Hedges and W. E. Hoare. *Metal Treatment,* v. 13, Autumn '46, p. 197-205.

Present position is that two electrodeposited tin-zinc alloy coatings, containing respectively 80% and 50% of tin are available for the protection of steel. The 80:20 coating is suitable for moist or salt-spray conditions, with excellent solderability. The 50:50 coating is more suitable for conditions of prolonged immersion in water or for applications where the coating is likely to become seriously damaged. Experimental work on this coating has not yet been published and it is too early to say what its applications may be.

8-147. **A Periodic Chart for Electroplaters.** George Dubpernell. *Iron Age,* v. 158, Nov. 28, '46, p. 51.

Periodic chart is designed to show the relation between elements which can be electrodeposited as metals from aqueous solutions.

8-148. **Brass Plating.** H. E. Zentler-Gordon and E. R. Roberts. *Metal Industry,* v. 69, Nov. 8, '46, p. 392-394.

Plating on steel and cast iron parts of brass of such structure and composition that it will readily bond to rubber. Analytical methods in present-day use.

8-149. **The Electrodeposition of Cobalt and Nickel From Coordination Compounds.** Margaret Davis Kramer, Sherlock Swann, Jr., and John C. Bailar, Jr. *Electrochemical Society Preprint* 90-27, Oct. '46, 7 p.

Series of cobaltic ammines and one of the nickel ammines, together with a few cobaltous ammines, were studied from the point of view of their function as electroplating agents. Data suggest that the nature of the coordinating groups, as well as the stability of the complex ions, is important in determining whether good plates will be formed. Test procedure and results.

8-150. **Military Applications of Electroplating in World War II.** William Blum. *Electrochemical Society Preprint* 90-32, Oct. '46, 8 p.

Deposits of chromium, nickel, copper, zinc and cadmium, lead, tin, silver, platinum group metals, and miscellaneous applications.

8-151. **Tin-Zinc Coatings.** *Tin and Its Uses,* v. 17, Oct. '46, p. 5, 14.

New method of preventing corrosion of steel by means of electrodeposited tin-zinc alloys. Three pages of color photographs show comparative results of corrosion tests using these coatings and others.

8-152. **Defects in Plating Solutions and Their Remedies.** P. Berger. *Journal of the Electrodepositors' Technical Society,* v. 21, '46, p. 195-209. (Reprint.)

Following types of solutions are dealt with: cadmium cyanide; chromium; copper (acid and cyanide); lead (fluoborate and sulphamate); nickel (Watts type and bright nickel); silver; sodium stannate and zinc cyanide. Emphasizes value of routine analysis of plating solutions as a preventive of serious troubles and resulting loss of production.

8-153. **The Control and Maintenance of Electroplating Solutions. Part I.** P. Berger. *Sheet Metal Industries,* v. 23, Nov. '46, p. 2153-2157.

Examples of various solution troubles, and practical hints on overcoming them. (To be continued.)

8-154. **Steel Pipe Electroplated Inside for Corrosion Resistance.** S. G. Bart. *Corrosion and Material Protection,* v. 3, Oct-Dec. '46, p. 8-10.

"Lectro-Clad process" electrolytically deposits a predetermined thickness of nickel or other corrosion resistant metals on the inside surface of pipe, tubing, fittings. Develops a smooth, ductile, pore-free deposit, fully adherent to the base metal in thicknesses of from 0.005 to 0.100 in. Development and perfection of new plating machine makes it possible to control solution composition, temperature, pH, surface speed, current density, and other variables.

8-155. **Acrylics Make Good Plating Barrels.** *Modern Plastics,* v. 24, Dec. '46, p. 128-129.

Details of fabrication and operation of Lucite plating barrel.

8-156. **Deposition of Metal on Plastics. (Concluded.)** E. A. Ollard and E. B. Smith. *Plastics,* v. 10, Nov. '46, p. 604-608.

Preliminary coating of the article; electrodeposition of the metal; polishing and finishing; plating of designs rather than complete coatings; plating for nondecorative purposes.

8-157. **Production Processes. Part XVIII. Electroforming.** Roger W. Bolz. *Machine Design,* v. 18, Dec. '46, p. 129-134.

History of electroforming and some of its applications.

8-158. **Copper Plating for Selective Carburizing.** A. O. Sayers. *Monthly Review,* v. 33, Dec. '46, p. 1271-1276, 1310.

Investigation revealed that failure of the copper plate to stop-off was caused by several factors not necessarily directly related to the plate. These factors, together with those immediately concerned with copper plating, are discussed.

8-159. **The Engineering Future of Plated Bearings.** Ralph A. Schaefer. *Monthly Review,* v. 33, Dec. '46, p. 1279-1283, 1315.

Fatigue strength, wear resistance and engine performance data show that plated metals and alloys usually perform similarly to equivalent cast bearing materials and that, in certain cases, their performance is superior to that of the cast materials. Metallurgical and mechanical advantages which characterize electrodeposited bearing materials known today.

8-160. **The Adhesion of Electrodeposits. Part V.** A. L. Ferguson. *Monthly Review,* v. 33, Dec. '46, p. 1285-1301.

Analysis and appraisal of information from literature and private communications on adhesion tests and their evaluation. Experimental work with adhesives. What is meant by "perfect" adhesion and "perfect" bond.

8-161. **The Significance of Polarization in Electroplating.** H. Bandes. *Metal Finishing,* v. 44, Dec. '46, p. 516-521.

Significance of polarization with respect to current efficiency, alloy deposition, structure of deposits and throwing power. Precision polarization data are required if many of the unknowns of the art of electroplating are to be understood.

8-162. **Plating With Gold.** H. M. Haberman. *Metal Finishing,* v. 44, Dec. '46, p. 525-528.

Four methods of plating with gold including the common processes for obtaining the various hues, such as red, green and white.

SECTION IX

PHYSICAL AND MECHANICAL TESTING

9-1. Experimental Verification of Cumulative Fatigue Damage. Milton A. Miner. *Automotive Industries,* v. 93, Dec. 1, '45, pp. 20-24, 56, 58.

Deals with means for evaluating the cumulative of cycles of stress at various stress levels. 8 ref.

9-2. Straining of Weld Metal During Cooling. E. Paul DeGarmo. *Iron Age,* v. 156, Dec. 20, '45, pp. 48-50.

Weld metal, in cooling, may be subjected to plastic strain greater than that corresponding to yield point of metal determined by tests.

9-3. The Importance of Reduction of Area in the Evaluation of High Carbon Steel Wire for Cold Drawing Purposes. D. A. Sutch and B. L. McCarthy. *Wire & Wire Products,* v. 20, Dec. '45, pp. 923-925, 962-963.

Reduction of area value, because of the fact that it will indicate austenitic grain size and degree of fineness of pearlite is a valuable tool in evaluation of air patented material as to its suitability for manufacture of quality wire. Air patenting treatment can, by use of reduction of area value, be brought to point of perfection. Reduction of area in as-patented condition can be employed as a control of final ductility of wire after drawing.

9-4. Cast Iron. A. B. Everest, J. W. Grant and H. Morrogh. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 545-550.

Development of a single-blow impact test employing the standard Izod machine.

9-5. Diamond Pyramid Hardness. W. N. Hindley. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 587-589.

Sources of error in measurements on hardened tool steel.

9-6. The Mechanism of Brittle Fracture. G. Stanley Smith. *Metallurgia,* v. 33, Dec. '45, pp. 55-58.

Role of external and internal defects during fracture; the order of formation of the parts of the new surfaces.

9-7. Comparative Properties of Cast and Forged Steel. C. E. Sims. *Metallurgia,* v. 33, Dec. '45, pp. 111-112.

Tensile and fatigue tests taken longitudinally and transversely from one forged and two centrifugal cast cylinder barrels heat treated by quenching in oil from 845° C.

and tempering back to a hardness of approximately 325 Brinell. Fatigue tests were carried out both on smooth and square-notch test bars, which were tested on a rotating beam machine to 7 million cycles and gave S-N curves of a very similar type.

9-8. **Tensile Properties of Aluminum Alloy Sheet at Elevated Temperatures.** Alan E. Flanigan, Leslie F. Tedsen and John E. Dorn. *Metals Technology,* v. 12, Dec. '45, T. P. 1929, 19 pp.

Temperatures from 75° to 375° employed with exposure times ranging up to 1000 hr. Effects of these variables on tangent modulus reported. Of materials tested 24S-T8 series appears to offer best possibilities for elevated temperature applications. Until fully aged, 24S-T and 24S-RT are lower in strength and may be expected to have lower corrosion resistance. Strength of 61S-W and 61S-T is lower than the 24S-TS series under all conditions tested, while XB75S-T suffers a rapid loss in strength at temperatures above 250° F. Tensile data obtained for aluminum alloys at elevated temperatures should be used with care. At the higher temperatures creep may become a significant factor and eventual failure by rupture may occur under steady loading at stresses well below the short-time "tensile yield stress." 11 ref.

9-9. **Creep Testing Equipment at Rustless Iron and Steel Corp.** E. E. Denhard. *Instruments,* v. 19, Jan. '46, p. 12.

Creep units employ a simple but sensitive means of maintaining strict uniformity with a minimum temperature variation.

9-10. **Proof Stress Determination.** R. A. Beaumont. *Aircraft Production,* v. 8, Jan. '46, p. 42-51.

Entirely new method for rapid routine testing; testing small specimens; developments in extensometer application.

9-11. **Hardness Testing.** *Iron and Steel,* v. 19, Jan. '46, p. 2.

New hydraulically operated semi-automatic machine; construction and operating details.

9-12. **Reversed Stress Testing of Piston Materials.** K. Wellinger and G. Staehli. *Automotive and Aviation Industries,* v. 94, Feb. 15, '46, p. 20-23, 66.

Piston metals were tested under application of heat for endurance load, under changing stress and strain and under overload; test procedure and results. (Translation of a German paper.)

9-13. **A Test for Hydrogen Embrittlement and Its Application to 17% Chromium, 1% Carbon Stainless Steel Wire.** Carl A. Zapffe and M. Eleanor Haslem. *Metals Technology,* v. 13, Jan. '46, T. P. 1954, 22 p.

Apparatus for measuring hydrogen embrittlement in wire as a function of the angle at which breaking occurs during a single bend made at constant speed. Instrument is used first to get an approximate indication of the sensitivity of various stainless grades of steel to hydrogen embrittlement, and then to study in detail certain factors controlling the absorption of hydrogen during cathodic and acid pickling and the desorption of that gas during subsequent recovery. Only two reagents, neither a com-

mercially advertised inhibitor, are found to be true inhibitors at certain concentrations; and at other concentrations they, too, aggravate embrittlement. Peculiarities of a group of these reagents are studied in detail. 13 ref.

9-14. **Novel Microhardness Tester and Its Application.** R. Woxén. *Engineers' Digest (American Edition),* v. 3, Jan. '46, p. 16-18.

New hardness number H_w—the Woxén number—can be defined as the major load divided by the indentation area, that is, the area of that part of the indenter which after removal of the major load is situated below the original level of the test piece. (Abstract from *Jerkontorets Annaler,* v. 129, 1945, p. 243-272.)

9-15. **Applications of Eberbach Microhardness Tester.** Howard E. Bernhardt. *Steel,* v. 118, Feb. 25, '46, p. 92-94, 96, 98, 100, 140.

Comparatively new apparatus employs a diamond penetrator so mounted that extremely light loads can be applied and small impressions made. Method is based upon microscopic measurement of plastic deformation. 6 ref.

9-16. **Fatigue Cracking of Coated Lead Alloys.** Lawrence Ferguson. *Bell Laboratories Record,* v. 24, Feb. '46, p. 53-56.

Investigation of effect on fatigue life of lead of polybutene coatings, antimony or calcium content, deflection, and rate of working.

9-17. **Rockwell Hardness Correction Factors.** *Materials and Methods,* v. 23, Feb. '46, p. 471, 473.

Correction factors in Rockwell values for both regular and superficial hardnesses set up in chart form.

9-18. **Damping Capacity.** L. Rotherham. *Metal Treatment,* v. 12, Winter, '46, p. 215-222, 232.

Engineering and physical aspects of damping and experimental methods for its determination. Effect of carbon and chromium content upon damping, and effect of cold work and magnetic properties. 10 ref.

9-19. **Testing Depth of Hardness.** L. Sanderson. *Metal Treatment,* v. 12, Winter, '46, p. 272-274.

A simple explanation of the uses and applications of the Jominy hardenability test.

9-20. **Single-Blow Impact Test for Cast Iron.** A. B. Everest, J. W. Grant and H. Morrogh. *Engineering,* v. 161, Feb. 1, '46, p. 117-120.

As iron castings are being employed under conditions of higher stressing and often in locations where they are subject to shock loading, a demand has arisen for a more definite evaluation of their impact properties. This paper records an investigation of this problem leading to the development of a test employing the standard Izod machine.

9-21. **Non-Destructive Etching Procedures and Hardness Values for Segregation of 24s, 14s, and 75s Aluminum Alloys.** Mary F. Grondona and Stuart Martin. *Aluminum and Magnesium,* v. 2, Feb. '46, p. 13-15.

Method developed was for the purpose of effecting a quick and non-destructive separation merely by observing the results of a chemical reaction between a chemical re-

agent and the surface or edge of the material involved. Chart shows various etching procedures, as well as hardness values, developed to identify the materials and their various tempers. Etch test procedures are greatly facilitated if the materials can be identified as bar, extrusions, or sheet stock.

9-22. **The Knoop Indenter as Applied to Testing Non-Metallic Materials Ranging From Plastics to Diamonds.** Vincent E. Lysaght. *American Society for Testing Materials Bulletin,* no. 138, Jan. '46, p. 39-44.

Knoop indenter with loads as light as 25 g. can be used to obtain an impression which has good definition. It can be used for testing brittle materials using loads up to a few thousand grams. Table gives indentation hardness numbers for minerals and some hard abrasives ranging from soft gypsum to diamond. 9 ref.

9-23. **The "E" Type Test Piece.** *Metallurgia,* v. 33, Feb. '46, p. 197-206.

Various types of test pieces were used in a large number of investigations to determine tensile properties of 10% magnesium-aluminum alloy used in an aircraft under-carriage support beam. Of the four designs tested, the "E" type test bar showed less deviation from the actual properties of the casting. Advantages are ease of casting the bar, smaller scatter and improved relationship between bars and castings.

9-24. **New Developments in Hardness Testing.** Vincent E. Lysaght. *Metallurgia,* v. 33, Feb. '46, p. 210-212.

The Tukon tester and Knoop indenter.

9-25. **Factors Affecting the Hardenability and Related Properties of Boron-Treated Steels.** R. A. Grange and T. M. Garvey. *Western Metals,* v. 4, Feb. '46, p. 29-32.

Hardenability of a boron-treated steel for a given application can be safely estimated only from the results of a hardenability test in which test sample is austenitized at the temperature to be used in hardening the final product. (Condensation of paper for American Society for Metals.)

9-26. **Tension Tests of Single-Row Spot-Welded Joints in 24S-T Alclad Aluminum Alloy Sheet.** R. Della-Vedowa. *Welding Journal,* v. 25, Feb. '46, p. 115s-122s.

Test procedure and results of the investigation.

9-27. **Rolling of Screw Threads.** H. Dinner and W. Felix. *Engineers' Digest (American Edition),* v. 3, Feb. '46, p. 85-86.

Number of tests were made to establish the characteristics of rolled threads under static as well as dynamic stress. In order to obtain comparative data, specimens of 1-in. thread were produced by *(a)* rolling, *(b)* cutting (lathe), *(c)* grinding, *(d)* milling. Test bar dimensions are shown. Results of static tensile and bending tests given. (Abstract from *Technische Rundschau Sulzer,* no. 1, '45, p. 131-134.)

9-28. **Impact Stress in Elastic Bodies Calculated by the Energy Method.** Merhyle F. Spotts. *Product Engineering,* v. 17, March '46, p. 200-204.

Procedure in applying the energy method to the solution of impact problems. Fundamental force, moment and energy equations are derived and used in equations for gravity acceleration and for calculating the stresses in bars and beams caused by the impact of moving weights. Torque equations are also derived for torsional impact in a rotating system.

9-29. **Defects in Steel and Their Detection.** A. J. K. Honeyman and A. Fisher. *Journal of the West of Scotland Iron and Steel Institute,* v. 52, Part III, Session 1944-45, p. 39-57.

Surface examination; deep-etch test; sulphur print test; step tests and inclusion counts; crack detection tests; fatigue test results showing effect of fillet radius.

9-30. **A Velocity-Modified Temperature for the Plastic Flow of Metals.** C. W. Macgregor and J. C. Fisher. *Journal of Applied Mechanics,* v. 13, March '46, p. A11-A16.

Velocity-modified temperature is developed for representing by means of a single variable the combined effects of strain rate and temperature on the stress reaction in a tension specimen. 11 ref.

9-31. **Testing the Wearing Quality of a Finish.** Arthur P. Schulze. *Industrial Finishing,* v. 22, March '46, p. 52, 54, 56.

How the wear testing device works; procedure followed in making a wear test.

9-32. **Hypersonic Nondestructive Testing of Material.** *Steel Processing,* v. 32, March '46, p. 171-173.

Method whereby a sound generator sends a beam through a specimen. Specimen, depending on its properties, modifies the beam and the resulting energy pattern is picked up on the side opposite the generator by means of a microphone. It is possible to select a critical set of radiation frequencies and electro-acoustic designs so that the resultant beams through the material are highly modified by any given type of flaw in any given material.

9-33. **Electronic Testing.** *Iron and Steel,* v. 19, March '46, p. 119-120.

Methods of quantity testing at high speeds.

9-34. **Testing Bolts for Strength and Ductility.** D. E. Lehane. *Fasteners,* v. 3, no. 2, '46, p. 7-9.

Proposes a standard method for determining strength and ductility of bolts.

9-35. **Repeated Loads on Riveted Joints.** G. A. Maney. *Fasteners,* v. 3, no. 2, '46, p. 14-15.

Large fatigue machine recently built to test riveted joints.

9-36. **The Behavior of Curved Panels in Compression.** *Aircraft Engineering,* v. 18, Feb. '46, p. 56-59.

Detailed investigation into effect of size and width of panel, edge conditions, grain of material, and initial imperfections on the behavior of curved panels under axial compression. With the exception of a few sheets of 17S-T light alloy 0.032 in. thick, the panels tested were of 24S-T and had a thickness of 0.036 in. When delivered the sheets were flat, and the desired radius of curvature of 24 in. was produced by cold rolling. To get reliable aver-

age results, the buckling tests were repeated, sometimes four times or more, with different specimens.

9-37. **Creep of Metals.** *Engineering,* v. 161, March 8, '46, p. 233-235.

Papers presented at an all-day conference in London, Feb. 5. Historical survey, by E. N. da C. Andrade; present state of experimental studies, by H. J. Tapsell; physical theory of creep, by E. Orowan; metallurgical control of creep, by N. Allen.

9-38. **Microhardness Testing of Materials.** V. E. Lysaght. *Metallurgia,* v. 33, March '46, p. 275-276.

Combined use of Knoop indenter and Tukon tester. (From *Materials & Methods,* v. 22, no. 4, 1945, p. 1079-1084.)

9-39. **Cast Iron—Modulus of Elasticity.** Alvin J. Herzig. *American Foundryman,* v. 9, April '46, p. 134-135.

Suggests that until fundamental work provides more knowledge of the elastic behavior of cast iron, it would seem wise to adhere to practice of calculating a relative modulus of elasticity from a carefully conducted transverse test with all its present empirical assumption. 10 ref.

9-40. **Method of Notching Impact Test Specimens.** S. E. Siemen. *ASTM Bulletin,* no. 139, March '46, p. 45-46.

Tool and technique developed will not only eliminate the difficulties associated with the machining of the standard 45° angle notch having a radius at the root of 0.010 in., but will enable the production of notches of any desired radius and angle in materials much harder than can be successfully notched by present methods.

9-41. **Improved Guides for Positioning of Impact Specimens.** J. R. Speer. *ASTM Bulletin,* no. 139, March '46, p. 46-47.

One device illustrated is used for Charpy testing and consists of a push button set into the side of the specimen supports of the impact tester. It is designed to act as a stop for positioning the specimen so that the notch is always centered between the anvils. The other device illustrated is used for Izod testing and consists of a sliding guide which is pushed into the notch of the Izod specimen to hold it in its correct location for testing. After the specimen is clamped in the vise, the guide springs back out of the way.

9-42. **Sources of Error in Diamond Pyramid Hardness Measurements.** W. N. Hindley. *Engineering,* v. 161, March 22, '46, p. 286-287.

An automatic machine has been developed for the rapid (120 per min.) hardness inspection of small steel components which are required to have a nominal diamond pyramid hardness number of 850 for acceptance. For its operation the machine depends upon the magnetic properties of the steel.

9-43. **Studies of Plastic Flow of Steel, Especially in Two-Dimensional Compression.** P. W. Bridgman. *Journal of Applied Physics,* v. 17, April '46, p. 225-243.

Results on experimental blocks subjected to two-dimen-

sional compressional stresses, while flow is also maintained two-dimensional. Transverse stress required to maintain two-dimensional flow is consistently higher than theoretical value. Discusses apparatus and method, theoretical background, approximately steady state measurements, velocity of flow, measurements with constant rate of flow, generalized strain hardening curve.

9-44. **Damping Capacity and the Fatigue of Metals.** R. F. Hanstock. *Engineering,* v. 161, April 12, '46, p. 358-360.

The research was undertaken to develop a method of fatigue testing which would allow determinations to be made of the damping capacity of the specimen during the course of the test. As a result of this work, it has been possible to investigate fatigue and damping capacity simultaneously for some aluminum alloys, and there is a reasonable expectation that eventually the method may be applied to a wide variety of materials.

9-45. **Fatigue Failures and Measures to Reduce Their Incidence.** *Electrical Manufacturing,* v. 37, May '46, p. 121-124, 216-224.

Resistance of metals to cyclic stresses can be measured by standardized laboratory methods and certain procedures are then available to the designer and production engineer for minimizing likelihood of service failures.

9-46. **Strength of Countersunk Screws in Shear and Tension.** Harold Adams. *Product Engineering,* v. 17, May '46, p. 380-383.

Results of an investigation of the strength of 100° and 82° countersunk flat head steel screws in lap joint shear and tension specimens. Allowable shear loads are established from load-deflection curves for both BAC and NAS screws. Results of tension tests are averaged and presented in tabular form.

9-47. **Tests Reported by Manufacturer Indicate That Zomag (Dowmetal) Line and Halftone Engravings Possess Maximum Wearing Qualities Under Repeated Stereotype Mat Molding.** W. Roy Manny. *Printing Equipment Engineer,* v. 72, May '46, p. 44, 46.

9-48. **Effect of Bend Width Upon Minimum Bend Radii.** George Gerard. *Journal of the Aeronautical Sciences,* v. 13, April '46, p. 161-170.

Bends of large width occasionally exhibit cracks at the center of the width when minimum bend radii successfully employed on small widths are used. An analysis of the stress condition existing at the center of a large width revealed an unfavorable biaxial tension stress that reduces the ultimate elongation from that in simple tension. An experimental photogrid strain survey on three aluminum alloys confirmed the results of analysis and indicated extent of biaxiality of stress as the width decreased. Elongation data from standard tensile coupons were corrected for biaxiality, and results then applied in determining theoretical minimum bend radii for various widths.

9-49. **The Determination of Proof Stress Without an Extensometer.** J. G. H. Brown. *Metallurgia,* v. 33, April '46, p. 301-302.

Method for determination of proof stress on very small test pieces. It is not pretended that the method evolved is very accurate, but it does provide information that otherwise would not be available in determining the properties of some components.

9-50. **Atmospheric and Indoor Aging Studies on Some Aluminum and Zinc-Base Die-Casting Alloys.** G. R. Gohn and Lucille E. Menges. *American Society for Testing Materials Preprint* 20, 1946, 31 p.

Results of indoor and outdoor aging studies covering a period of 15 yr. on 12 aluminum and nine zinc-base die-casting alloys. 16 ref.

9-51. **Mechanical Methods of Testing—Analysis of the Tensile Stress in the Neck of an Elongated Test Specimen.** N. N. Davidenkov and Miss N. I. Spiridonova. *American Society for Testing Materials Preprint* 27, 1946, 12 p.

A method which utilizes a microscopic test of polished surfaces to obtain a more or less correct understanding of the true stress condition in the neck of the specimen and to find the relationship between the average stresses as recorded by a testing machine and the true local stresses, by which the mechanical properties of the material can be determined. Translated from Russian. 10 ref.

9-52. **The Fatigue Strength of Lap Joints in Some Magnesium Sheet Alloys.** H. J. Grover and L. R. Jackson. *American Society for Testing Materials Preprint* 28, 1946, 9 p.

Data on the direct-stress fatigue strength of riveted, spot welded, heliarc welded, and cycle welded joints in J-h, J-a, and M-h type magnesium sheet alloys.

9-53. **The Fatigue Strength of Some Magnesium Sheet Alloys.** L. R. Jackson and H. J. Grover. *American Society for Testing Materials Preprint* 37, 1946, 13 p.

Data on the direct-stress fatigue strength, and notch sensitivity of magnesium sheet alloys of the J-h, J-a, M-h, M-a, and FS-h and FS-a types.

9-54. **Influence of Strain Rate and Temperature on the Mechanical Properties of Monel Metal and Copper.** D. J. McAdam, G W. Geil, and D H. Woodard. *American Society for Testing Materials Preprint* 54, 1946, 49 p.

Relation between creep rate, temperature, flow stress, breaking stress, and ductility; a general view of the influence of strain rate and temperature on the mechanical properties of monel metal and oxygen-free copper between −188° C. and the melting points. Decrease in temperature or increase in strain rate increases the cohesion limit to a greater extent than the flow stress; the ductility thus increases.

9-55. **The Effect of Notches on Static and Fatigue Strength.** D. W. Drake. *Journal of the Aeronautical Sciences,* v. 13, May '46, p. 259-269.

Factors governing notch strength, both from a static strength and from a fatigue strength standpoint. An increase in yield ratio will usually increase the static efficiency of notched specimens but this increase may be limited by the ability of the material to strain. Use of high-strength aluminum alloys in airplane structures

may result in appreciable reduction in structural weight for same static strength but this may be accompanied by a reduction in fatigue strength of the structure.

9-56. **The Necking of Tensile-Test Specimens.** J. D. Lubahn. *Transactions of the American Society of Mechanical Engineers,* v. 68, May '46, p. 277-279.

Strains encountered in long rectangular tensile test bars of the aluminum alloys 24S-O and 24S-T have been investigated in detail. Theoretical conceptions previously advanced regarding the necking of tensile test bars have been confirmed experimentally.

9-57. **Instability of Thin-Walled Tubes Subjected to Internal Pressure.** G. Espey. *Transactions of the American Society of Mechanical Engineers,* v. 68, May '46, p. 281-285.

Experimental analysis to support the theoretical conception advanced for the necking of tubing subjected to pure longitudinal tension, to balanced biaxial tension, and to plane strain with the major strain being circumferential. Stress-strain curve in uniaxial tension can be used to predict the necking strain for tubing under various stress states.

9-58. **Stress-Rupture Characteristics of Various Steels in Steam at 1200° F.** J. T. Agnew, G. A. Hawkins and H. L. Solberg. *Transactions of the American Society of Mechanical Engineers,* v. 68, May '46, p. 309-315.

Small tensile specimens were placed in a steam reaction chamber at 1200° F. and stressed in tension for periods of time ranging from 10 hr. to 7700 hr. Materials tested were carbon steels, carbon-molybdenum, chromium-molybdenum and chromium-nickel steels. Data taken on time to rupture, elongation, reduction in area, depth of scale layer, effect of type of flow. and type and angle of fracture. Photomicrographic study made of the ruptured specimens. Straight-line relationship between stress and time to rupture on log-log coordinates postulated by White, Clark and Wilson for tests in air also holds for tests in steam.

9-59. **Prestressing Rotating Disks.** Herbert Dobkin. *Steel,* v. 118, June 3, '46, p. 104-106, 150.

Rotating disks used in turbines and compressors, subjected to a 10 to 20% overspeeding in test stands, receive permanent plastic deformation and high residual compressive strength.

9-60. **Tension Testing at Elevated Temperatures.** T. M. Blackman, P. R. Mourse, and E. H. Plesset. *ASTM Bulletin,* no. 140, May '46, p. 32-37.

Simple and inexpensive method of heating tension specimens by resistance, a method of measuring specimen temperatures, and two types of extensometers and the associated electronic equipment for use with a Baldwin-Southwark recorder. One extensometer is a reworked compressometer for use in the elastic range. Other measures elongations up to 50% of a 2-in. gage length for studies in the plastic range. Tension specimen may be broken without damaging the latter extensometer. Calibrating adjustments have seen set so that 50% elongation results in a

10-in. record (of the elongation) on a Baldwin-Southwark tension machine recorder; the elastic range is necessarily so foreshortened that it is not discernible on the record. Also discusses technique for determining the true load at fracture of ductile specimens.

9-61. **A German Investigation into the Sag of Steel and Aluminum Transmission Lines.** *Aluminium and the Non-Ferrous Review,* v. 2, Jan-March '46, p. 2-4, 14.

Description of testing system; object and results of test. Modulus of elasticity and heat expansion coefficient used in calculating sag. Combined or compounded value involves computations for both steel and aluminum.

9-62. **Impact Strength of Arc Welds.** H. O. Klinke. *Aero Digest,* v. 52, June '46, p. 82-83.

Investigation conducted recently on the impact strength of metallic-arc welded butt joints in S.A.E. X4130 steel. Several ferritic and austenitic type filler metals were used and impact strengths ascertained in both the as-welded and heat treated condition. Type of impact specimen selected was the simple beam type (Charpy) with a keyhole notch. Notch was variously located in weld metal, at the boundary of weld and parent, and in the parent metal.

9-63. **A Photo-Electric Method of Measuring Damping in Metal Forks at Elevated Temperatures.** T. E. Pochapsky and W. J. Mase. *Journal of Applied Mechanics,* v. 13, June '46, p. A157-A161.

Details of construction of the equipment and tests performed to establish its accuracy.

9-64. **Failure of Ductile Metals in Tension.** G. Sachs and J. D. Lubahn. *Transactions of the American Society of Mechanical Engineers,* v. 68, May '46, p. 271-279.

Theory of necking is developed in order to predict the forming limits for various stress or strain states based upon an analysis of the true stress-strain curve in pure tension. A criterion for necking is advanced, based upon the maximum-load (or pressure) conception of instability, and is applied to different geometrical shapes formed at room temperatures.

9-65. **Torsional Vs. Tensile Properties of Steels.** Maurice C. Fetzer. *Steel,* v. 118, June 24, '46, p. 92-94, 118, 123.

Steels representing typical microstructures were tested and results analyzed to determine relationship between torsional and tensile properties. It was found that tensile test is a better means of determining yield points, but that torsional test measures strength and ductility in a more fundamental way.

9-66. **"Hypersonic" Nondestructive Material Testing.** H. B. Shaper. *Instruments,* v. 19, June '46, p. 327-330.

Locating flaws in solid materials is now possible by a new method in the application of supersonic waves. Successful applications have been made in the fields of rolled sheets, tires, knots in wood, built-up aircraft sections employing laminations, structures of wood and aluminum, plating, etc.

9-67. **Damping Capacity and the Fatigue of Metals.** R. F. Hanstock and A. Murray. *Engineering,* v. 161, April 19, '46, p. 381-383.

The relations between damping capacity and fatigue of various metallic materials are investigated.

9-68. **Lockwasher Breakage Resulting From Hydrogen Embrittlement.** Walter L. Fleischmann. *Product Engineering,* v. 17, July '46, p. 150-152.

Simple test procedures and methods of preventing failures. Progressive failure typical of hydrogen embrittlement is described and illustrated. Information for specifications is included as well as precautions to be observed in manufacture.

9-69. **Microhardness Testing of Fine Wire and Small Parts.** G. E. Shubrooks. *Wire and Wire Products,* v. 21, July '46, p. 515-518, 548.

The Tukon tester which incorporates an electrical device for reducing impact between the specimen and the indenter. Hardness readings may be recorded as Knoop numbers or may be converted to Rockwell hardness numbers. Extremely shallow hardness indentations are made possible. Indenter is a pyramidal diamond cut to the angles indicated. It is applied to a polished metal surface with a load of 25 to 3600 g., depending on the relative hardness and thickness of the metal being tested.

9-70. **Training Spark Testers.** E. W. Lundahl. *Iron Age,* v. 158, July 18, '46, p. 65-67.

Training program equally suitable for the development of skilled testers for other steel products, teaches the apprentice to judge accurately to $\pm 0.02\%$ carbon in C1010 and C1025 steels. Sparking characteristics of carbon, silicon, sulphur, phosphorus, molybdenum, nickel, and chromium are discussed in detail.

9-71. **Evaluating Surface Durability of Gears.** T. H. Wickenden, G. R. Brophy, and A. J. Miller. *Machine Design,* v. 18, July '46, p. 142-146.

Ingenious testing machine for determining the surface durability of gears. Typical test data are included and an account given of the testing procedure, which employs a noise meter to determine the point at which destructive failure begins.

9-72. **Testing Bolts for Strength and Ductility.** D. E. Lehane. *Steel,* v. 119, July 22, '46, p. 86-87, 134, 136.

Proposes a standard method for determining these properties.

9-73. **X-Ray Diffraction Study of Notch-Bend Test.** J. T. Norton, D. Rosenthal, and S. B. Maloof. *Welding Journal,* v. 25, May '46, p. 269s-276s.

Using the X-ray diffraction technique the authors demonstrated that the notch had no effect on the initiation of plastic flow, and that the latter set according to the strain-energy criterion. On the other hand, plastic flow had a considerable effect on the stress concentration factor. Amounts of plastic flow which were not greater than those occurring in the so-called brittle failure were sufficient to reduce the stress concentration to almost nothing. This reduction was associated with the production of a compressive stress at and around the notch which has resulted in an apparent strain hardening.

9-74. **Critical Review of the Weld Stress Problem.** J. T. Norton and D. Rosenthal. *Welding Journal,* v. 25, May '46, p. 277s-282s.

The primary object of the weld stress program appears to be the solution of the problem of brittle failures. In order to prepare a workable basis for this solution, the conditions of brittle failure have been reviewed and the factors, both physical and chemical, analyzed in some detail.

9-75. **DeForest Brittle Temperature Research.** Paul R. Shepler. *Welding Journal,* v. 25, June '46, p. 321s-332s.

The work described is concerned with locating the ductile-brittle transition temperature of a given material for a given load velocity and specimen constraint in order to determine if a material at low temperature is unusually brittle or unusually ductile. Test method is to observe for a given notched specimen in bending the plastic deformation of a load-deflection record. Automatic plots of load and deflection are used and insure obtaining these temperatures accurately. Materials tested include welded and unwelded nonkilled ship plate, mild steel, silicon-killed Navy high-tensile steel, wrought iron and others. 27 ref.

9-76. **A Method for the Measurement of Residual Welding Stresses.** J. L. Meriam, E. Paul DeGarmo and Finn Jonassen. *Welding Journal,* v. 25, June '46, p. 340s-343s.

Experimental work in the welding investigation has shown that the method described here for the measurement of residual weld stresses, averaged over the plate thickness, gives satisfactory results. Experience has shown that the over-all accuracy of this stress measurement technique is within $\pm$ 2000 psi. which is within the limits of reproducibility of residual welding stresses using controlled standard welding procedures.

9-77. **An Investigation of the Fatigue Strength of Spot Welds in the Aluminum Alloy Alclad 24S-T.** W. F. Hess, R. A. Wyant, F. J. Winsor and H. C. Cook. *Welding Journal,* v. 25, June '46, p. 344s-358s.

One of a series of progress reports on aircraft spot welding research conducted at Rensselaer Polytechnic Institute. Evaluates from the standpoint of repeated stress some of the results obtained in other parts of the experimental program. The single-spot lap weld type of specimen was used. The tests consisted of repeatedly varying the load on these specimens from fixed minimum values of 10, 30 and 50% to specific higher percentages of the static shear strength until failure occurred.

9-78. **Standard Test Bars for the Nonferrous Foundry.** Frank Hudson. *Foundry Trade Journal,* v. 79, June 20, '46, p. 185-191.

Recommends that Keel bar should be tentatively adopted as a standard for copper-base alloy castings. 6 ref.

9-79. **Hardness Testing.** *Iron and Steel,* v. 19, July '46, p. 435.

New diamond indenter for finished surfaces is suitable for use on thin metal, plated or casehardened surfaces,

hard brittle materials and in other testing fields where the testing load must be kept below 3600 g.

9-80. **Hot Workability—A Quantitative High-Temperature Torsion Test.** *Iron and Steel,* v. 19, July '46, p. 449-450.

Description of a torsion test at elevated temperatures for determining the hot workability of metals devised by Harry K. Ihrig of Globe Steel Tubes Co. 2 ref.

9-81. **Fatigue Cracks in Retaining Rings of Turbine Generators.** J. B. Swering. *Power Plant Engineering,* v. 50, July '46, p. 92-94.

Nature of such fatigue cracks.

9-82. **Magnetism and the Testing of Materials.** R. V. Band. *Engineering,* v. 162, July 12, '46, p. 41-42.

A mathematical treatise. (Translation of *Schweiz. Tech. Zeitschrift,* Oct. 11, '45, p. 517. Abridged.)

9-83. **A Method of Testing Thin Sheet Material in Compression.** Baxter C. Madden. *Journal of the Aeronautical Sciences,* v. 13, July '46, p. 346-352.

Method of determining the compressive mechanical properties of thin sheet material. The test jig, specimen, and details of the testing procedure are described, and the detection of buckling and the measurement of friction between the specimen and the jig are discussed. Results on 0.035-in. thick steel, 0.040-in. aluminum alloy sheet and 0.020-in. thick clad aluminum alloys are given. Ease of specimen preparation, simplicity of the jig, and the assurance of low friction between the specimen and its supporting plates are advantages of the test. 5 ref.

9-84. **Evaluation of the Surface Durability of Gears.** T. H. Wickenden, G. R. Brophy and A. J. Miller. *Automotive and Aviation Industries,* v. 95, Aug. 1, '46, p. 36-40.

Primary concern in these tests is with the deterioration of the teeth surfaces which fail by pitting rather than with the beam fatigue strength of the teeth. Test specimen and testing machine; gear life indication; stress calculation; nature of failure.

9-85. **Control Tests for Gray Cast Iron.** *Foundry Trade Journal,* v. 79, July 18, '46, p. 287-297.

Quick check tests which may be made on gray cast irons to insure that metal delivered from a foundry melting furnace is suitable for the casting or castings for which it is intended. Tests described are: visual tests or those which quickly produce some directly observable characteristic phenomena in the actual metal; rapid analytical methods; mechanical tests which in many cases merely anticipate those subsequently required by inspecting authorities. (Paper read before Institute of British Foundrymen, June 1946.)

9-86. **Thermal Stresses in Wrought Steel Wheels.** Reid L. Kenyon. *Railway Mechanical Engineer,* v. 120, Aug. '46, p. 400-405.

Stress theory of thermal cracking of rims, and of extensive plate ruptures accompanying rim failures, developed and demonstrated by ten years of study in Armco labora-

tory. Improved wheel-testing machine developed by Armco engineers.

9-87. **Brittle Fracture of Steel Under Sustained Load at Elevated Temperature.** C. Schaub. *Engineers' Digest,* v. 3, July '46, p. 333-334.

To obtain general information with regard to the tendency to embrittlement of 16 steels, specimens were subjected to a 1000-hr. test at 500° C. Impact tests were carried out both before and after the 1000-hr. test. Conclusion is that the ordinary limiting creep stress test should be complemented by a corresponding test on notched test bars. In the latter test a stable material should not exhibit any tendency to embrittlement or to fissure formation in the notch similar to stress-corrosion. (Abstracted from *Jernkontorets Annaler,* v. 130, no. 1, 1946, p. 1-26.)

9-88. **Hardenability Testing in Material Control.** E. H. Snyder. *Steel,* v. 119, Aug. 26, '46, p. 72-73, 120, 123-124.

In quenching and tempering gears, bolts and studs, several factors are important, principally hardness and depth of penetration. Relates how hardenability testing successfully fits into one company's use of standard and alloy steels.

9-89. **Temperature Coefficients for Proving Rings.** Bruce L. Wilson, Douglas R. Tate, and George Borkowski. *Journal of Research of the National Bureau of Standards,* v. 37, July '46, p. 35-41.

Temperature-correction factors must be used in computing ring loads from deflections obtained at temperatures that differ from the temperature of calibration. Temperature coefficients for 14 representative rings were computed from calibration results obtained at temperatures of 70 and 100° F. Temperature coefficient of a proving ring is shown to be equal to the temperature coefficient of Young's modulus of elasticity plus twice the coefficient of thermal expansion of the material of the ring. 10 ref.

9-90. **Drill-Pipe Testing.** George Weber. *Oil and Gas Journal,* v. 45, Aug. 31, '46, p. 72-75, 84.

Evaluation of testing methods now in use and discussion of possible new methods.

9-91. **Control Tests for Gray Cast Iron. (Continued.)** *Foundry Trade Journal,* v. 79, July 25, '46, p. 311-316.

Analytical methods—spectrographic, colorimetric, gravimetric or volumetric, spot tests; mechanical tests; metallographic methods.

9-92. **A Small-Scale Creep Testing Unit.** G. T. Harris. *Metallurgia,* v. 34, July '46, p. 129-132.

Small creep testing machine described. Some results are given showing the form of the strain-time curves obtained.

9-93. **Verification of Tensile Testing Machines.** W. Thompson. *Metallurgia,* v. 34, July '46, p. 145-146.

Comparative ease of checking accuracy of tensile testing machines by means of the steel proving-ring method described.

9-94. **Control Tests for Gray Cast Iron. (Continued.)** *Foundry Trade Journal,* v. 79, Aug. 1, '46, p. 337-345, 351.

Temperature measurement; thermocouple details; factors in calibration; synopsis of rapid analytical methods: silicon, manganese, sulphur, phosphorus, nickel, chromium, molybdenum. 34 ref.

9-95. **Measuring Errors in Diamond Pyramid Hardness Tests on Hardened Steel.** W. N. Hindley. *Industrial Diamond Review,* v. 6, Aug. '46, p. 242-244.

Sources of error, method for minimizing them, and recommended procedure for surface preparation.

9-96. **Micro-Hardness Testing.** E. Borje Bergsman. *Metal Industry,* v. 69, Aug. 9, '46, p. 109-112.

Description of a technique developed in Sweden. Tester has been designed for use with any standard inverted microscope with only slight modifications in the attaching device to suit various types of stage and objective holder.

9-97. **Fatigue Strength of Weldments Used to Reinforce and Repair Steel Bridge Members.** Wilbur M. Wilson. *American Railway Association, Bulletin 460,* v. 45, June-July '46, p. 19-33.

Investigation of fundamentals and two series of tests made specifically because of their interest to the railroads. One series consisted of fatigue tests of flexural members and the other consisted of fatigue tests of bridge reinforcements.

9-98. **New Form of Notched-Bar Test Piece.** W. E. Woodward. *Engineering,* v. 162, Aug. 9, '46, p. 123.

New form requires less shop work to prepare, and test results compare closely with those obtained with standard test pieces.

9-99. **Some Anomalies and Some Refinements in the Diamond Pyramid Hardness Testing of Heavily Cold Rolled Strip.** Thomas B. Crow and John F. Hinsley. *Journal of the Institute of Metals,* v. 72, July '46, p. 461-485.

Conditions under which it may be not inaccurate to report a diamond pyramid hardness number from the measurement of one diagonal only have been studied, and the use of the geometric mean of the diagonals has been considered. Difference in length of the diagonals in any one indentation has been correlated with the load and with the directional properties of the strip. Attention directed to serious errors in diamond pyramid hardness which may result from neglecting to take convexity into account. Geometric form of the bulge curve examined, and results applied to calculations of area. Geometry of diamond indentation studied in detail, and a technique of refined measurement and calculation developed.

9-100. **Pneumatic Fatigue Test.** *Steel,* v. 119, Sept. 9, '46, p. 112-113, 150, 152.

Details on a method for fatigue testing gas turbine buckets which may apply to a wide variety of parts subjected to reversed bending stresses.

9-101. **Testing of Highly Loaded Sleeve Bearings.** J. Palsulich and R. W. Blair. *S.A.E. Journal,* v. 54, Sept. '46, p. 481-490.

Describes test program, lists specific properties of bearings being investigated and describes in detail test equipment and procedure used. Curves and tables show results obtained. Usefulness of laboratory test rigs in accelerating the development of new bearing materials and designs is stressed.

9-102. **Testing Abrasion Resistance of Plated and Coated Surfaces.** Arthur P. Schulze. *Die Casting,* v. 4, Sept. '46, p. 56-58, 60, 62.

Standardized measurements can be made giving accurate data regarding the service life of any type of finish, using instrument described.

9-103. **An Autographic Method for Obtaining Load-Extension Records of High-Speed Tensile Tests on Sheet Specimens at Elevated Temperatures.** Alan E. Flanigan. *Journal of the Aeronautical Sciences,* v. 13, Aug. '46, p. 405-409.

Apparatus has been used successfully at temperatures up to 900° F. and at strain rates as high as 1 per sec. Typical results are shown to illustrate the effects of testing temperature and strain rate on the load-extension curves for XB75S-O alclad sheet.

9-104. **Testing Cylindrical Forgings.** J. E. Petermann. *Steel,* v. 119, Sept. 16, '46, p. 96-98, 150.

Method for static testing thin-walled cylindrical forgings of austenitic chromium-nickel steel which are subjected to stresses approaching the yield strength of the material. Test consists of subjecting the cylinder to a high internal pressure, which stresses the forged ring beyond the yield strength. Forging, if not up to par, will show signs of failure such as surface cracks on either the bore or outside surface; also a poor stress-strain curve will result. By cold working the ring, the yield point of the material is increased.

9-105. **The Fatigue Behavior in Reverse Bending of Welded Sheet Steel.** R. L'Hermite and D. Severian. *Welding Journal,* v. 25, Sept. '46, p. 512s-517s.

Preliminary tests intended to find out whether the fatigue test is a suitable means for the investigation of weldability of thin plates used in the aircraft industry. Detailed description of the fatigue testing machine, preliminary fatigue results on samples of thin steel plates of various composition and an extensive investigation of a large mild steel plate tested as delivered and butt welded.

9-106. **Quantitative Measurement of the Cracking Tendency in Welds.** R. D. Stout, L. J. McGready, and G. E. Doan. *Welding Journal,* v. 25, Sept. '46, p. 522s-531s.

Method described for evaluating quantitatively the tendency of a weld to crack during cooling. Data presented show that changes in electrode, in steel composition and in plate temperature each result in significant and predictable variations in the cracking tendency. Specimen believed suitable for the study of both weld metal cracks and base metal cracks.

9-107. **A Method for Evaluating Toughness of Steel.** S. A. Herres and A. F. Jones. *Metal Progress,* v. 50, Sept. '46, p. 462-469.

Contests the idea that high reduction of area is a good criterion of toughness (ability to absorb energy by deformation) and proposes criterion based on tensile strength at 70° F. and Charpy V-notch impact test at −40° F., presenting a diagram showing relationship of these two values in tough steels at various strength levels.

9-108. **A Study of the Damaging Effect of Fatigue Stressing on S.A.E. X4130 Steel.** John A. Bennett. *Journal of Research of the National Bureau of Standards,* v. 37, Aug. '46, p. 123-139.

Damage was measured by decrease in endurance at another stress. A deflection method for detecting the formation of a fatigue crack showed that the apparent rate of damage depends on the stress history. Tests also were made with smooth specimens in an effort to determine cumulative damage caused by fatigue at more than one stress. Two methods were developed for extrapolating to determine the point at which fatigue cracking starts, so the damaging cycle ratios could be based on the life of the specimens prior to cracking. Complete S-N curves were determined for specimens after each of eight different damaging treatments. Method of expressing damage was developed that permitted the direct addition of damage occurring at different stresses. Reliability of method was checked by testing specimens after fatigue loading at two or more different stresses and comparing the results with predictions based on the addition of the indicated damage.

9-109. **Significance of Impact-Test Data in Design of Engineering Structures.** D. F. Windenburg. *Product Engineering,* v. 17, Sept. '46, p. 81-83.

Examination of Charpy specimens after test reveals that specimens that absorb high values of energy exhibited a considerable amount of ductility, whereas those tested below the transition temperature at which little energy was absorbed showed no signs of ductility. It is recommended that acceptance specifications for materials to be used under tensile loading, especially at low temperatures, require impact tests to insure adequate ductility at the structure's working temperature.

9-110. **Efficiency of Plates in Riveted Tension Joints.** F. P. Cozzone. *Product Engineering,* v. 17, Sept. '46, p. 88-91.

Proposed method for estimating the efficiency of plates in riveted lap joints subjected to tension loads. Summary of tests on 100 specimens covering a wide range of rivet patterns; comparison of ultimate loads as predicted by A. R. E. A. method and the proposed method with the actual test loads.

9-111. **Fatigue Strength of Steel Forgings.** C. Lipson and G. Noll. *Product Engineering,* v. 17, Sept. '46, p. 130-131.

Authors clarify misunderstanding concerning the fatigue strength of forged steel parts used in the as-forged condition, as shown by discussion and comment that developed after the presentation of the paper "Allowable Work-

ing Stresses for Steel" in the March 1946 issue of *Product Engineering*.

9-112. **Modern Hardness Testing Machines.** *Industrial Diamond Review,* v. 6, Sept. '46, p. 263-267.

An abstract of a number of articles reviewing German hardness testing machines and their working mechanisms.

9-113. **The Effect of Rate of Strain on Mild Steel.** R. P. Andrew. *Engineering,* v. 162, Aug. 23, '46, p. 171-172.

Experimental testing machine and technique and high-speed photographic methods used. Results tabulated and conclusions drawn.

9-114. **Compression and Impact Tests for Steel Acceptance Proposed.** D. F. Windenburg. *Civil Engineering,* v. 16, Oct. '46, p. 442-443.

Standard tests do not measure compressive yield strength or notch sensitivity at low temperatures. Research at the Navy's David Taylor Model Basin has shown that an accurate measure of these mechanical properties is essential if failures are to be avoided. Recommends development of new, rapid, and automatic tests to ensure the performance of steel in economically designed structures.

9-115. **Diamond Hardness Testing.** *Metal Industry,* v. 69, Sept. 13, '46, p. 223, 226.

Detailed and painstaking study of various methods of computing the necessary corrections on "bulging". The equation of the bulge curve closely approximates that of a parabola, and on this basis, a modified method for determining hardness number is proposed.

9-116. **Testing Engine Bearings.** J. Palsulich and R. W. Blair. *Aircraft Production,* v. 8, Sept. '46, p. 409-413.

Special rigs and procedure for investigation of behavior under high loads.

9-117. **Hardness Testing.** *Aircraft Production,* v. 8, Sept. '46, p. 442-443.

Electromagnetic properties of ferrous materials used as a basis for rapid and accurate checking. Electronic methods described offer economy in both time and labor.

9-118. **Effect of Surface Scratches on Alclad Sheet.** *Iron Age,* v. 158, Oct. 3, '46, p. 40.

Series of tests were undertaken by Lockheed Aircraft Corp. to determine quantitative effect of surface scratches on the strength and formability of aluminum alloy sheet.

9-119. **Stress-Rupture and Creep Tests on Aluminum Alloy Sheet at Elevated Temperatures.** A. E. Flanigan, L. F. Tedsen, and J. E. Dorn. *Metals Technology,* v. 13, Sept. '46, T.P. 2033, 32 p.

Five high-strength aluminum alloy sheet materials have been subjected to stress-rupture and creep tests at temperatures from 94 to 375° F. In each test the following data were obtained: fracture time, elongation at fracture, creep rate, creep intercept, and the complete strain-versus-time curve.

9-120. **Standard Test-Bars for the Nonferrous Foundry.** *Foundry Trade Journal,* v. 79, Aug. 29, '46, p. 451-454; v. 80, Sept. 12, '46, p. 31-37.

Discussion of Frank Hudson's paper in June 20th issue. Outlines a series of detailed tests with a slightly modified form of the A.S.T.M. bar and provides a comparison of the effect of test-bar design on 86-7-5-2 gunmetal.

9-121. **Finish Testing Equipment. No. IX. Impact Tester.** *Organic Finishing,* v. 7, Sept. '46, p. 45.

Impact tester for adhesion and brittleness of organic coatings.

9-122. **Brinell Hardness of Gray Cast Iron.** James T. MacKenzie. *Foundry,* v. 74, Oct. '46, p. 88-93, 191, 194.

Data from experimental heats and from actual operations contributed by seven firms. Tables and graphs relate Brinell hardness number to tensile strength and elasticity for various types of gray cast iron. Charts show results of statistical analyses of data from 1553 tests.

9-123. **Calculation of Tensile Strength and Yield Point From the Chemical Composition and Cooling Rate.** Irvin R. Kramer, P. D. Gorsuch, and D. L. Newhouse. *Metals Technology,* v. 13, Sept. '46, T. P. 2067, 28 p.

Presents methods of calculating tensile strength and yield point of steels from chemical composition and suggests a method of correlating tensile strength, yield point factors and cooling rate.

9-124. **Effect of Inert Atmospheres on Fatigue Tests.** H. J. Gough and D. G. Sopwith. *Engineering,* v. 162, Aug. 30, '46, p. 197-198.

Effect of water vapor in absence of oxygen was evaluated by tests in humidified nitrogen. Metals tested were 70:30 brass and annealed copper. For copper, the tests show that decrease in fatigue limit due to atmosphere is caused by the combined action of oxygen and water, but by neither alone. For brass, the interpretation of the results is more difficult.

9-125. **Surface Durability.** *Automobile Engineer,* v. 36, Sept. '46, p. 407-408.

Reviews recent American investigations into the deterioration of gear teeth.

9-126. **An Empirical Approach to the Fatigue Strength Analysis of Structures.** Henry W. Foster and Victor Seliger. *Journal of Applied Mechanics,* v. 13, Sept. '46, p. A201-A206.

Method of fatigue strength analysis for fabricated structures, based on laboratory fatigue test data, is proposed. Nature of structural fatigue strength is discussed with the view of defining the necessary correlating assumptions and the type of experimental data needed. Example is presented for structures fabricated from alclad 24S-T aluminum alloy and analysis results are compared with actual test results.

9-127. **Tension Tests at Constant True Strain Rates.** *Journal of Applied Mechanics,* v. 13, Sept. '46, p. A243-A252.

Discussion of paper by C. W. MacGregor and J. C. Fisher, which appeared in the Dec. 1945 issue. Includes report of recent Russian investigation dealing with calculation of true stresses and true strains at the minimum diameter of tension test bars of Armco iron stretched to various degrees of reduction of the cross-sectional area.

9-128. **An Improvised Hardness Test.** Theodore F. Burch. *Metal Progress,* v. 50, Oct. '46, p. 661.

Close determinations of hardness of steel parts can be made by means of a vise, a steel ball from a ball bearing (approximately ½ in. in diameter), blocks of steel with known hardness values, and a Brinell microscope or other means of measuring ball impressions.

9-129. **Effect of Ratio of Rivet Pitch to Rivet Diameter on the Fatigue Strength of Riveted Joints of 24S-T Aluminum Alloy Sheet.** Harold Crate, David W. Ochiltree, and Walter T. Graves. *National Advisory Committee for Aeronautics Technical Note no. 1125,* Sept. '46, 7 p.

Results of an extensive series of tests conducted on riveted joints to determine the effect of rivet size and rivet pitch on the fatigue life of joints subjected to "prying" (combined tensile and bending) loads.

9-130. **Temperature Effects Being Studied on Large Welded Girders.** La Motte Grover. *Engineering News-Record,* v. 137, Oct. 17, '46, p. 100-101.

Describes Bureau of Standards test program in which six 9-ton welded steel box girders are being subjected to load tests. Tests on the first three have been completed and results are described. The first and the third girder were tested at room temperature and the second at −45° F. The third girder was made of special fully killed steel, while the rest were ordinary semikilled steel.

9-131. **Microhardness Testing.** E. B. Bergsman. *Industrial Diamond Review,* v. 6, Oct. '46, p. 301-302.

Application of microhardness testers to scratch and indentation tests. (Condensation from *Teknish Tidskrift,* v. 74, 1944.)

9-132. **An Investigation of the Phenomenon of Cleavage-Type Fractures in Low-Alloy Structural Ship Steels.** Harold J. Gershenow and George G. Luther. *Welding Journal,* v. 25, Oct. '46, p. 611s-615s.

Tensile tests of two types of flat bar specimen were made which substantiated the supposition that various combinations of temperature and constraint can produce cleavage fractures in normally ductile steel by simple tension loading. It was shown that high constraint at room temperature, less constraint at moderately low temperatures, and no constraint other than that inherent in conventional tensile specimen at very low temperatures will produce brittle failures.

9-133. **Hardness Testing of Metals and Alloys at Elevated Temperatures.** Frederick P. Bens. *American Society for Metals Preprint,* no. 3, 1946, 9 p.

Principles of the diamond pyramid penetration method of hardness testing have been embodied in an apparatus for determining the hardness of metals at temperatures up to 1700° F. Apparatus is designed to rest on the stage of a standard Vickers hardness machine and to employ the loading device and optical system thereof. A vacuum chamber protects the test specimen, diamond indenter, and heating element against oxidation at high temperature. Hardness and strength of some alloys at elevated

temperatures are recorded. In stable alloys the hardness at elevated temperatures appears to be a useful index of elevated temperature strength.

9-134. **The Measured Knoop Hardness of Hard Substances and Factors Affecting Its Determination.** Newman W. Thibault and Helen L. Nyquist. *American Society for Metals Preprint,* no. 23, 1946, 54 p.

Discusses in detail the factors which may influence the measured Knoop hardness number, especially of hard, brittle substances. Specifies conditions under which a determination of the Knoop hardness number of such substances should be carried out, and tables give consistent series of Knoop numbers determined in this manner for a variety of materials ranging in hardness from boron carbide down to hardened toolsteel, Rockwell C-60.5.

9-135. **A Failure-Sequence Indicator for Static Test Specimens.** R. W. Powell. *Transactions of the American Society of Mechanical Engineers,* v. 68, Oct. '46, p. 763-766.

An instrument is described which has been used to determine the location of initial failure in static tensile-test specimens. Its particular usefulness in aircraft structural development is discussed and technical details of its operation are presented.

9-136. **Testing Big Girders for Shops.** *Welding Engineer,* v. 31, Nov. '46, p. 85-86.

Tests were carried out on six 9-ton welded structural carbon steel box girders of 22-ft. span. Very abusive welding procedures and sequences were used, along with some unfavorable details of design, for the deliberate purpose of producing the highest possible residual stresses.

9-137. **Screw-Driven Creep-Rupture Testing Machine.** M. J. Manjoine. *Metal Progress,* v. 50, Nov. '46, p. 1100-1101.

New device uses no weights, requires no extensometer, and automatically draws a creep curve for each specimen tested. Has automatic recording equipment which traces an individual creep curve for each test. Can readily be adapted for short-time tensile tests, constant strain-rate tests, or relaxation tests.

9-138. **The Measurement of the Adhesion of Unvulcanized Rubber to Metal.** C. M. Blow. *Journal of Scientific Instruments,* v. 23, Oct. '46, p. 227-229.

Method for measuring the adhesion of metal to unvulcanized rubber or rubber-like materials involves the observation of the angle at which a metal ball rolls off the rubber surface when it is tilted. Experimental results confirm the theoretical basis of the method and illustrate its value in studying the processing characteristics of rubber compounds.

9-139. **Self-Tapping Screws.** A. C. Millard. *Mechanical Engineering,* v. 68, Nov. '46, p. 935-942.

Result of fastening-strength tests of self-tapping screws in various materials which were carried out at the Bell Telephone Laboratories, Inc.

9-140. **The P-V Test, a New Hardenability Measure.** E. S. Kopecki. *Iron Age,* v. 158, Nov. 14, '46, p. 66-69.

Method for determining hardenability of low and medium hardening steels, whereby economy in sample preparation and excellent reproducibility in results have been attained, is proposed. P-V test symbolizing "penetration-velocity" or "penetration-V shape"—designed for steels with critical cooling rates above 100° F. per sec.—eliminates the undesirable features inherent in present hardenability testing methods. Has proved useful in establishing cooling rate data of many steels.

9-141. **Testing Light Metal Surface Finishes for Wearability.** Arthur P. Schulze. *Modern Metals,* v. 2, Nov. '46, p. 24-26.

Method of evaluating the wear factor on surface finishes for aluminum and magnesium alloys.

9-142. **Ductility of Metals and Alloys Used in Construction —II.** Georges Welter. *Metallurgia,* v. 34, Oct. '46, p. 304-310.

Results of tests made on construction materials in order to establish a classification, with respect to their ductility, of light metals and alloys in comparison with other heavy structural materials. Effect of notching under axial and eccentric loads also investigated. Standard and special notched specimens were tested under axial and eccentric loads producing single tension as well as combined tension and bending stresses.

9-143. **X-Ray Diffraction Study of the Effect of Residual Compression on the Fatigue of Notched Specimens.** J. T. Norton, D. Rosenthal and S. B. Maloof. *Welding Journal,* v. 25, Nov. '46, p. 729s-735s.

Preloading notched specimens in tension has resulted in residual compressive stresses without appreciably cold working the metal and noticeable improvement of fatigue performance. Use of preloading as a means of improvement of fatigue resistance of metal parts containing stress raisers is discussed with particular emphasis on spot welding. 11 ref.

9-144. **The Rapid Determination of the Elastic Limit in Steels.** J. R. Cornelius. *Machinery (London),* v. 69, Nov. 7, '46, p. 590-591.

Experiments carried out with the Cornelius electronic comparator prove conclusively that the elastic limit of a steel can be definitely plotted and that proportional elongation occurs for some considerable period after. Additional equipment necessary for such a test includes tensile testing equipment which can indicate load with fair accuracy.

9-145. **A New Microhardness Tester With Knoop Indenter.** J. F. Richardson and H. K. Worner. *Industrial Diamond Review,* v. 6, Nov. '46, p. 348.

This instrument incorporates a mechanism for applying and controlling the magnitude of the load. Indenter and loading mechanism are contained in a cylindrical casing which screws onto one side of the dual objective holder of the microscope, while a medium-low-power objective is held in the other side. The indenter is spring loaded and load is applied by moving the microscope tube downward by means of its rack and pinion gear. Results of tests on dental materials.

9-146. **Comparison of Various Structural Alloy Steels by Means of Static Notch-Bar Tensile Test.** G. Sachs, L. J. Ebert, and W. F. Brown, Jr. *Metals Technology,* v. 13, Dec. '46, T.P. 2110, 17 p.

Various steels or heats of the same steel treated to yield identical properties in the conventional tensile test may exhibit widely different service performance, except for the impact test, particularly at low temperatures. Laboratory tests in general have failed to yield clearly defined criteria for such differences. Authors have applied their static notch-bar tensile test to this problem with excellent success, since large differences were revealed where none were apparent when other testing methods were used. Test results shown graphically. 11 ref.

SECTION X

ANALYSIS

10-1. Vacuum-Fusion Method for Determining Gases in Non-Ferrous Metals. H. A. Sloman. *Engineering,* v. 160, Nov. 9, '45, p. 385.

Vacuum fusion methods for analysis of oxygen, nitrogen and hydrogen are applied to non-ferrous metals. Results are extremely promising, and have definitely established the usefulness of the method for several metals and alloys, particularly light alloy types.

10-2. An Apparatus for the More Accurate Determination of Hydrogen Liberated From Acids by Metals. B. S. Evans and D. G. Higgs. *Analyst,* v. 70, Oct. '45, pp. 356-362.

Evolved in an attempt to improve technique of evaluating metal content of, say, magnesium, by determining volume of hydrogen given off when it is dissolved in acid. The process falls naturally into two stages, evolution and measurement. 4 ref.

10-3. A Composite Method for the Determination of Silicon, Manganese and Phosphorus in Cast Iron and Steel. T. S. Harrison. *Analyst,* v. 70, Oct. '45, pp. 362-365.

Investigation to determine silicon gravimetrically, phosphorus absorptiometrically by phosphovanadamolybdate technique, and manganese by absorptiometry or titration, all on a single sample of iron or steel. 3 ref.

10-4. The Determination of Iron, Manganese and Aluminum in Bronzes and Brasses After Separation of Copper as Oxalate. F. H. Edwards and J. W. Gailer. *Analyst,* v. 70, Oct. '45, pp. 365-368.

Iron, manganese and aluminum are found to be completely recovered after copper is separated by oxalic acid. Iron and manganese are then determined colorimetrically with a spectrophotometer and aluminum is precipitated with phenylhydrazine and ignited to Al_2O_3. 2 ref.

10-5. The Determination of Mercury as Mercuric Iodate. C. H. R. Gentry and L. G. Sherrington. *Analyst,* v. 70, Nov. '45, pp. 419-421.

The precipitation of mercury as mercuric iodate and its subsequent gravimetric and volumetric determination are described. Possible interferences from some other elements are discussed. 4 ref.

10-6. The Determination of Small Quantities of Silica, Alumina and Lime in Tungsten Carbide Powder. C. E. A. Shanahan. *Analyst,* v. 70, Nov. '45, pp. 421-423.

Method involves the separation of the tungsten by volatilization as chloride and oxychloride. Volatilization in a mixture of gaseous hydrochloric acid and air does not result in any appreciable loss of the constituents being determined, even when temperatures in the neighborhood of 850° C. are employed with a chloroform vapor-air mixture. However, the volatilization temperature must not exceed about 650° C.; otherwise partial volatilization of the silica and alumina will occur. Colorimetric method based on the production of molybdenum blue from the reduction of ammonium silicomolybdate has been shown to be reliable where the silica content of the sample is low. 6 ref.

10-7. The Determination of Traces of Sulphur Dioxide—With Special Reference to the Determination of Sulphur in Ferro-Alloys. G. Ingram. *Analyst,* v. 70, Nov. '45, pp. 423-426.

Method can be applied to the determination of sulphur dioxide in amounts above 2 mg. Absorption is effected with neutralized hydrogen peroxide solution, the resulting sulphuric acid is allowed to react with copper oxide, and a colorimetric procedure is used to determine amount of soluble copper salt formed. Amount of copper found, divided by two, equals sulphur content of sample. Results given show that an accuracy of 100 $\pm$ 2% can be attained. 4 ref.

10-8. Vacuum-Fusion Method for Determining Gases in Non-Ferrous Metals. H. A. Sloman. *Engineering,* v. 160, Nov. 16, '45, pp. 404-405.

Application to high melting point metals and low melting point metals. (Paper for Institute of Metals.)

10-9. Steel Segregates. J. Convey and J. H. Oldfield. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 580-584.

Micro-spectrographic method for quantitative analysis.

10-10. Iron & Steel Analysis. Ernest C. Pigott. *Iron & Steel,* v. 18, Dec. '45, pp. 641-645.

Research required; reporting results; aluminum; carbon; chromium; use of fluorides; carbide decomposition; rapid determination of small amounts of chromium (0.20%) in plain and alloy steels.

10-11. The Effect of Sodium Silicates on Iron Oxide Surfaces. Fred Hazel. *Journal of Physical Chemistry,* v. 49, Nov. '45, pp. 520-537.

Investigation to study the effect of silicate composition in relation to the colloidal behavior of the systems. Colloidal ferric oxide was used as the reference system. Mobility and stability measurements were made in experiments conducted at different hydrogen-ion activities. The silicates employed varied in sodium oxide—silica ratio from 1:1 to 1:4. Results given. 12 ref.

10-12. The Micro-Analytical Chemistry of Antimony. F. T. Beaumont. *Metallurgia,* v. 33, Dec. '45, pp. 101-103.

Methods of detection, separation and determination of small amounts of antimony.

10-13. A Direct Polarographic Determination of Lead and Cadmium in Potassium Cyanide Solution. M. Spalenka. *Metallurgia,* v. 33, Dec. '45, pp. 106-107.

Polarographic procedures are described for determination of 10 to 30% Pb in lead bronze; determination of 0.08 to 4.0% Pb in copper alloys; determination simultaneously of 0.001 to 2.0% Pb and 0.001 to 1.0% Cd in zinc and its alloys and in zinciferous materials.

10-14. Determination of Nitrogen in Ferro-Alloys by Direct Nesslerization. W. C. Newell. *Engineering,* v. 160, Dec. 14, '45, p. 505.

Analytical procedure for steels and alloys; analytical procedure for organic materials.

10-15. The Micro-Spectrographic Analysis of Steel Segregates. J. Convey and J. H. Oldfield. *Engineering,* v. 160, Dec. 7, '45, p. 481-484.

Segregation in steel is examined by traversing the sample with a highly localized condensed spark in conjunction with a moving spectrographic plate. Presents in detail the progress of the investigation of the variation in element concentration across segregates in steel. Seven elements were studied, namely, silicon, manganese, nickel, chromium, molybdenum, vanadium and carbon.

10-16. A Colorimetric Method for the Determination of Uranium in Leach Liquors. T. R. Scott and P. Dixon. *Analyst,* v. 70, Dec. '45, p. 462-465.

A new method has been developed for the colorimetric estimation of uranium, using the yellow color of uranium salts in solution. The color reaches a maximum in the presence of not less than 10% sulphuric acid or 4% phosphoric acid. Color is proportional to concentration over the range 0.15 to 0.75% U_3O_8 and by the use of a blue filter, interference due to copper and vanadium (quadrivalent) can be eliminated. 2 ref.

10-17. The Determination of Carbon in Ferrous Materials. J. B. Cotton. *Analyst,* v. 70, Dec. '45, p. 466-468.

Relative merits of gravimetric and volumetric finishes to the combustion method for the determination of carbon in ferrous materials. A semi-automatic method employing a volumetric finish which uses a barium chloride, sodium hydroxide absorbent in evacuated bottles described. 1 ref.

10-18. Polarographic Determination of Nickel in Copper Base Alloys. G. W. C. Milner. *Analyst,* v. 70, Dec. '45, p. 468-474.

Procedures for the polarographic determination of nickel are given for copper-base alloys, both zinc bearing and zinc free, and bronzes. Methods for both large and small amounts of nickel. 3 ref.

10-19. Novel Test Sample Speeds Tap Carbon Analysis. *Steel,* v. 118, Jan. 28, '46, p. 148.

White hot steel in a glass tube saves valuable furnace time in preparing a slag-free sample for carbon analysis.

10-20. Evaluation of Spectrographic Analytical Data. H. V. Churchill and J. R. Churchill. *Industrial and Engineering Chemistry (Analytical Edition)*, v. 17, Dec. '45, p. 751-754.

Precision data on the spectrographic analysis of metals illustrates value of a simple statistical approach to the handling of a large number of separate data. 8 ref.

10-21. Spectrochemical Determination of Small Amounts of Aluminum in Steel. Robert Spiers, Philip Fischer and Kenneth L. Proctor. *Industrial and Engineering Chemistry (Analytical Edition)*, v. 17, Dec. '45, p. 772-774.

A spectrochemical method for the determination of aluminum in steels with a range from 20 to 500 micrograms per sample. Method was developed employing a mercury cathode separation and a final spectrographic procedure of sparking a concentrated solution of aluminum. 34 ref.

10-22. Spectrophotometric Determination of Titanium in Steels. Alfred Weissler. *Industrial and Engineering Chemistry (Analytical Edition)*, v. 17, Dec. '45, p. 775-777.

Absorption spectra have been determined for the hydrogen peroxide complexes of titanium and vanadium in the presence of 1 g. of iron, in perchloric-phosphoric acid solution. Spectra furnish the basis for improved, rapid, accurate methods for the determination of from 0.5 to 6 mg. of titanium in iron, steel, vanadium steel, and stainless steel, without separating the titanium or using hydrofluoric acid; accuracy approaches one part per hundred.

10-23. Lead in Smelter Products. William Hered and Grace R. Hered. *Industrial and Engineering Chemistry (Analytical Edition)*, v. 17, Dec. '45, p. 780-781.

An improved quantitative method for lead in smelter products was devised in which preliminary separations are unnecessary for the materials investigated. An acceptable degree of accuracy is obtained and the time required is reduced considerably. Diffusion current constants for lead in 1 *N* hydrochloric acid and in alkaline tartrate are reported. 5 ref.

10-24. Rapid Method for Determination of Copper in Steel —Especially Suitable for Foundry Control. Frederick B. Clardy, John C. Edwards and John L. Leavitt. *Industrial and Engineering Chemistry (Analytical Edition)*, v. 17, Dec. '45, p. 791-792.

Method for rapid and accurate determination of copper in plain and alloy steels for foundry control. The total time for the analysis is approximately 15 min. Its accuracy makes it suitable as a standard method for copper in steel up to 1.3% with a maximum error of less than 0.02. The method involves precipitation of copper as cuprous thiocyanate from a perchloric acid solution and subsequent titration of the cuprous thiocyanate by the Andrews method, using chloroform and potassium iodate. 27 ref.

10-25. Determination of Nitrogen in Refractory Metal Carbides and Their Compositions. John C. Redmond, Leona Gerst and W. O. Touhey. *Industrial and Engineering Chemistry (Analytical Edition)*, v. 18, Jan. '46, p. 24-26.

Determining nitrogen in refractory metal carbides by

the solution and distillation method. No special apparatus is required and precise results are obtained. The nitrogen contents of several representative carbides and compositions are given.

10-26. **Colorimetric Determination of Nickel in Bronzes.** G. Haim and B. Tarrant. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Jan. '46, p. 51-52.

Copper is separated by precipitation with ammonium hypophosphite and subsequent filtration. The nickle is then determined by measurement of the color produced by dimethylglyoxime in the presence of citric acid, iodine, and ammonia. The method is rapid (one determination can be completed in less than 30 min.) and of sufficient accuracy for routine purposes. 16 ref.

10-27. **Iron and Steel Analysis.** Ernest C. Pigott. *Iron and Steel,* v. 19, Jan. '46, p. 7-12.

Cobalt; copper; lead; manganese; method for manganese in alloy steel; rapid colorimetric method for the determination of molybdenum in steels; color instability; phosphorus; determination as the phospho-salt of molybdenum blue; determination as phospho-vanado-molybdate; strychnine-molybdate methods.

10-28. **The Photometric Determination of Silicon in Aluminum Alloys.** H. Cox. *Metallurgia,* v. 44, Jan. '46, p. 121-122.

Factors governing the determination of silicon in aluminum alloys by means of the molybdenum blue reaction investigated. Method insures speedy color development, gives reproducible results, and has been found satisfactory for the determination of silicon up to 15% in aluminum alloys. 11 ref.

10-29. **A New Method for the Absorptiometric Determination of Chromium in Low Alloy Steels by Oxidation With Potassium Bromate.** M. Z. De Lippa. *The Analyst,* v. 71, Jan. '46, p. 34-37.

New absorptiometric method has been developed which obviates disadvantages of methods available and enables chromium to be very rapidly determined in low alloy steels with a reasonable degree of accuracy. 5 ref.

10-30. **Application of Colorimetry to the Analysis of Corrosion Resistance Steels.** Oscar I. Milner. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Feb. '46, p. 94-96.

Photometric measurement of the cuprammonium ion is best made at 580 millimicrons, where the effects of ammonia concentration and other ions that may be present are negligible. Interference at 620 millimicrons, the region of maximum sensitivity, is significant. Rapid procedure, applicable to low alloy and corrosion resistant steels, is given and data are presented in support of the validity of the method. 16 ref.

10-31. **Rapid Photometric Determination of Iron in Aluminum Alloys.** Michael Stevens Pepi. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Feb. '46, p. 111-112.

Method for the photometric determination of iron in aluminum alloys is based on the reaction of ferrous iron

and 1, 10-phenanthroline. Formation, stability, and reproducibility of the reaction of ferrous iron and 1, 10-phenanthroline. Method is rapid and the accuracy obtained is ±0.05% of the amount present. 7 ref.

10-32. **Precipitation of Platinum Metals by Organic Monosulphides. Determination of Platinum With Thiophenol and Rhodium With Thiobarbituric Acid.** J. E. Currah, W. A. E. McBryde, A. J. Cruikshank, and F. E. Beamish. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Feb. '46, p. 120-122.

Actions of seven organic monosulphide compounds with some of the platinum and related metals. Rhodium may be determined gravimetrically with thiobarbituric acid. Thiophenol may be used as a precipitant in the gravimetric determination of platinum. 15 ref.

10-33. **Hexamethylenetetramine in Separations of Titanium and Columbium.** Karl W. Traub. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Feb. '46, p. 122-124.

Procedure for gravimetric determination of titanium in ferrotitanium alloys, in which hexamethylenetetramine eliminates the use of hydrogen sulphide for removal of iron. Sodium hydroxide and hexamethylenetetramine are used in a procedure for determining columbium, titanium, or both in high chromium-nickel steels containing tungsten, vanadium, and molybdenum. Procedures are believed to be applicable to determination of zirconium. 7 ref.

10-34. **Determination of Metallic Copper in Cuprous Oxide-Cupric Oxide Mixtures.** Irvin Baker and R. Stevens Gibbs. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Feb. '46, p. 124-127.

Procedure and reaction outlined. Difficulties in the analysis of commercial copper and cuprous oxide pigments, due to physical characteristics of the pigments, are presented. Effects of exposure time, temperature, atmosphere, and solvents are listed. 1 ref.

10-35. **Determination of Magnesium in Aluminum Alloys.** Henry C. Deterding and Richard G. Taylor. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Feb. '46, p. 127-129.

Analytical method of making the initial separation of magnesium hydroxide in the presence of other alloying constituents held in solution as complexes formed under controlled pH conditions. Final determination of magnesium may be a simple spectrophotometric measurement, a volumetric titration, or a gravimetric weighing.

10-36. **Iron and Steel Analysis.** E. C. Pigott. *Iron and Steel,* v. 19, Feb. '46, p. 61-62.

Recent developments with regard to silicon, sulphur, zirconium. 14 ref.

10-37. **Estimation of Zinc in Aluminum Alloys by Means of Quinaldinic Acid.** J. H. Bartram and P. J. C. Kent. *Metallurgia,* v. 33, Feb. '46, p. 179-182.

Possible to estimate the zinc content of all classes of

aluminum alloys using quinaldinic acid, over a range of 0 to 14% zinc. Method is accurate and reasonably fast, and has been adapted for routine analysis. 11 ref.

10-38. **The Application of 8-Hydroxyquinoline to the Analysis of Aluminum Alloys.** Paul E. Gagnon and Henri Shehyn. *Aluminium and the Non-Ferrous Review,* v. 10, Oct-Dec. '45, p. 76-79.

Method described. Some difficulties appeared which were found to be due to a salting-out of manganese oxinate by sodium chloride present in the solution. Nickel was found to interfere owing to adsorption of nickel oxinate on the magnesium oxinate precipitate.

10-39. **Spectrograph Technique on the Charging Floor.** J. T. Rozsa. *Iron Age,* v. 157, March 28, '46, p. 42-46.

Construction details and application of spectrograph planned to service both openhearth and electric furnaces.

10-40. **Rapid Method for the Photometric Determination of Iron in Aluminum Alloys.** Michael S. Pepi. *Aluminum and Magnesium,* v. 2, March '46, p. 12-13, 20-21.

Reaction of 1,10-phenanthroline and iron basis of investigation; reaction of ferrous iron and 1,10-phenanthroline produces an orange-colored solution; color intensity varies with the iron concentration and can be measured accurately with a spectrophotometer; method outlined.

10-41. **Color Determination of Tungsten, Titanium and Columbium.** Charles M. Johnson. *Iron Age,* v. 157, April 4, '46, p. 66-69.

A rapid method for the quantitative determination of titanium in the presence of tungsten, columbium and vanadium. In addition to the various analysis procedures, samples of mathematical computation also given.

10-42. **Application of Thioglycolic Acid to the Spectrophotometric Determination of Iron in Ores.** J. P. Mehlig and M. J. Shepherd. *Chemist Analyst,* v. 35, Feb. '46, p. 8-9, 11, 14.

Method depends upon reducing the iron with hydroxylamine hydrochloride and measuring the light transmittancy at 535 $m\mu$ of the colored solution produced by thioglycolic acid in ammoniacal solution. Results agree closely with those obtained by the dichromate titrimetric method and give further evidence that it is possible to determine macroconstituents spectrophotometrically. 16 ref.

10-43. **Symposium on Polarography.** *Analyst,* v. 71, Feb. '46, p. 49-65.

General principles of polarographic analysis. Biochemical application of polarographic analysis. Inorganic applications of polarographic analysis, with special reference to aluminum, magnesium and zinc. Applications of polarographic analysis to the examination of high-purity selenium, nickel and cobalt compounds. 37 ref.

10-44. **A Method for the Determination of Selenium in Steels, With Notes on the Determination of Sulphur.** B. S. Evans. *Analyst,* v. 71, Feb. '46, p. 68-70.

Method consists of solution in dilute sulphuric acid containing 10 g. potassium permanganate. MnO_2 is dissolved by addition of oxalic acid and selenium is precipitated by boiling with sodium hypophosphite. After purification the determination is completed using iodimetic technique. A special note for treatment of 18-8 steels is included.

10-45. **The Precipitation of Tin by Tannin.** H. Holness and W. R. Schoeller. *Analyst,* v. 71, Feb. '46, p. 70-74.

Tin (stannic) is quantitatively precipitated by tannin from chloride solution at 0.05 *N* acidity. Tin can thus be separated from iron, vanadium, aluminum, beryllium, copper, and lead and determined gravimetrically as SnO_2 after ignition of the tannin precipitate washed free from chloride. 12 ref.

10-46. **The Determination of Magnesium in Nickel Alloys.** J. T. Minster. *Analyst,* v. 71, Feb. '46, p. 74-77.

Permanently installed piece of apparatus for separating magnesium from nickel by electrolysis with a mercury cathode. The magnesium is subsequently determined volumetrically by means of 8-hydroxyquinoline.

10-47. **Determination of Tungsten in Silicate Rocks.** E. B. Sandell. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, March 29, '46, p. 163-167.

Colorimetric method which is suitable for determining tungsten in silicic and medio-silicic rocks for geochemical purposes. As little as 0.5 part per million of tungsten can be detected when a 1-g. sample is taken. Method involves separation of tungsten from iron and titanium by sodium hydroxide precipitation, elimination of molybdenum as sulphide with antimonic sulphide as collector, and final determination of tungsten with stannous chloride and potassium thiocyanate. 14 ref.

10-48. **Determination of Beryllium in Ores.** Mary H. Fletcher, Charles E. White, and Milton S. Sheftel. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, March '46, p. 179-183.

A fluorometric method using quinizarin in an alkaline citrate solution has been developed for the determination of beryllium in ores. Preparation of the sample for analysis consists essentially of fusion with sodium carbonate and borax glass, solution of the melt in hydrochloric acid, and proper dilution. Directions are given for removal of other ions when necessary. Simple visual comparator or a photo-electric instrument may be used for the measurements. Effect of changes in dye concentration and beryllium content on the characteristics of the fluorescence, the influence and removal of other ions, and the effect of light, temperature, and time are discussed.

10-49. **New Method for Determination of Manganese.** James J. Lingane and Robert Karplus. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, March 29, '46, p. 191-194.

Method is based on the potentiometric titration of manganous ion with permanganate ion in neutral pyrophosphate solution. Method is applicable without any separa-

tions to a wide variety of manganiferous metallurgical products, and it yields very accurate results.

10-50. **Spectrophotometric Determination of Traces of Nickel.** O. R. Alexander, Edith M. Godar and N. J. Linde. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, March '46, p. 206-208.

Rapid and precise method of determining traces of nickel in foods and biological materials and in ferrous materials has been developed. The optimum range is 5 to 80 micrograms and in this range the determinations are accurate to ±5%. Nickel is separated from interfering elements by a solvent extraction of the dimethylglyoxime salt of divalent nickel, and is determined by spectrophotometric measurement of the yellow diethyldithiocarbamate complex.

10-51. **Modified All-Dithizone Method for Determination of Traces of Copper.** S. L. Morrison and Harriet L. Paige. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, March '46, p. 211-215.

Modified all-dithizone procedure in which the copper is extracted in Mojonnier fat-extraction flasks and determined by the mixed color method. Interference and contamination by likely metallic ions are eliminated. Data on recoveries of added copper to several biological products are given. Recoveries of better than ±0.2 microgram are obtained.

10-52. **Modified Moly Spot Test.** *Iron Age,* v. 157, April 11, '46, p. 49.

Sensitivity of modified test is such that N.E. and S.A.E. 4000 steels can be separated from nonmolybdenum-type steels, as well as steels with high residual molybdenum content from steels to which molybdenum has been intentionally added (such as N.E.8600). Procedure; a few precautions to be observed.

10-53. **Determination of Tungsten and Columbium in Stainless Steels.** C. M. Johnson. *Iron Age,* v. 157, April 11, '46, p. 66-68.

Determination of tungsten and columbium together in stainless steels containing titanium, molybdenum and about 18% chromium and 10% nickel.

10-54. **An Introduction to Metallurgical Spectrographic Analysis.** D. M. Smith. *Foundry Trade Journal,* v. 78, March 21, '46, p. 311-314.

Qualitative analysis; semiquantitative analysis; accurate analysis with the microphotometer; effects of alloying constituents and metallurgical history; preparation of electrodes; analytical accuracy; improving the accuracy of spectrographic analysis.

10-55. **The Chemical Determination of Tantalum and Niobium in Tungsten-Bearing Heat Resisting Steels.** E. W. Harpham. *Metallurgia,* v. 33, March '46, p. 245-247.

Brief review of recently published methods for the chemical determination of tantalum and niobium. Method for routine determination in tungsten-bearing heat resisting steels. Importance of determining both tantalum and niobium contents.

10-56. **Spectrographic Analysis.** A. Walsh. *Metal Industry*, v. 68, March 29, '46, p. 243-245.

New, simple and inexpensive light source unit for spectrographic analysis of metals and alloys. (From British Non-Ferrous Metals Research Association Bulletin 201, March, 1946.)

10-57. **Shop Tests for Identifying White Metals.** *Oxy-Acetylene Tips*, v. 25, April '46, p. 43.

Four simple tests—magnetic, nitric acid, iron nail, and cupric chloride solution test. Used to identify nickel, monel, copper-nickel alloy, steel, cast iron, Ni-Resist, stainless steels and Inconel.

10-58. **A Method for Determining Small Amounts of Gold, and Its Use in Ascertaining the Thickness of Electrodeposited Gold Coatings.** W. Stanley Clabaugh. *Journal of Research, National Bureau of Standards*, v. 36, Feb. '46, p. 119-127.

Punch and die used to obtain samples of known small area of gold electroplate. Amounts of gold up to 10 micrograms, corresponding to a thickness of 0.00050 mm. or less on 1 sq. mm. of surface, are determined directly by means of the color produced with o-tolidine. Results are reported for thicknesses of gold plate on experimentally plated samples and on commercially plated products.

10-59. **Spectrographic Analysis.** A. Walsh. *Metal Industry*, v. 68, April 5, '46, p. 263-265.

Results of tests made with duralumin indicate the degree of reproducibility obtainable.

10-60. **Spectrographic Analysis of Nickel Deposit on Steel.** J. H. Terry. *Better Enameling*, v. 17, April '46, p. 6-7.

Steel sheets were sparked on spectrograph and the results compared with a simultaneously sparked standard steel plate, previously analyzed chemically. Sheet was laid on the flat top surface of a Petrey spark stand. Spark was directed between the sheet and carbon electrode, sharpened to a 120° cone point, which was placed 2 mm. below the steel sample. Excitation conditions used to produce the spark are listed in a table.

10-61. **Spectrographic Analysis.** A. Walsh. *Metal Industry*, v. 68, April 12, '46, p. 293-294.

Results of reproducibility tests summarized in tables for aluminum and lead alloys.

10-62. **The Spectrochemical Analysis of Steels With a Direct-Reading Instrument.** M. F. Hasler, J. W. Kemp and H. W. Dietert. *ASTM Bulletin*, no. 139, March '46, p. 22-25.

Practically every phase of steel testing from residual impurity measurements to alloying constituent determinations can be handled by instruments described, at rate of from 1 to 2 min. per sample. Results obtained with a commercially available direct-reading instrument known as the Quantometer, indicate that it is practical to apply this type of instrumentation to the routine control analysis of steel and, as a corollary, to the analysis of other metals and alloys.

10-63. Applications of the Intermittent A.C. Arc Technique of Spectrographic Analysis. J. A. C. McClelland. *Analyst,* v. 71, March '46, p. 129-139.

Intermittent a.c. arc technique has been applied to materials in which the elements are not present in the metallic state. Two variants are described, one for very small quantities of one or two elements in simple conditions, the other for larger amounts of a number of common elements. In general, an accuracy of about ± 5 to 10% of the proportion of the element present is attainable by either method.

10-64. Mechanical Brain for Magnesium Analysis. *Dow Diamond,* v. 9, March '46, p. 6-10.

Dow's direct-reading spectrometer discloses contents of magnesium alloys in less than 60 sec.

10-65. Colorimetric Determination of Iron in the Presence of Large Concentrations of Copper and Nickel. R. H. Greenburg. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, April '46, p. 255-257.

Usefulness of disodium-1, 2-dihydroxybenzene-3, 5-disulphonate as a chromogenic reagent for the determination of iron has been extended. Technique has been applied which allows estimation of iron in the presence of large quantities of copper and nickel. As little as 0.025% iron in blue vitriol can be estimated without prior separations.

10-66. Determination of Cobalt in High-Cobalt Products. Separation From Iron by Phosphate. R. S. Young and A. J. Hall. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, April '46, p. 262-264.

Method is given in which cobalt is separated from iron in high-cobalt products by one precipitation with tribasic sodium phosphate. Since all the conditions for the reaction can be precisely controlled, the method is extremely accurate and can be used for research or referee work. Cobalt can be determined electrolytically directly following the removal of iron and aluminum by this procedure, chromium, nickel, and vanadium being the only common interfering elements.

10-67. Colorimetric Determination of Cobalt With Ammonium Thiocyanate. R. S. Young and A. J. Hall. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, April '46, p. 264-266.

Rapid and accurate colorimetric method is given whereby cobalt may be determined in the presence of other common ions. This method can be extremely valuable in the laboratories of mining and metallurgical industries where routine determinations of cobalt are carried out. Useful range for procedure lies within the limits 0.01 to 4.0% cobalt.

10-68. Commercial Use of Direct-Reading Spectrochemical Analysis of Magnesium Alloys. J. L. Saunderson and T. M. Hess. *Metal Progress,* v. 49, May '46, p. 947-955.

Detailed comparison of the direct-reading method with the conventional photographic method. Factors such as the relative costs of the equipment, costs per analysis,

relative accuracy, and operating personnel are considered. Present and future applications of direct-reading spectrochemical analysis are discussed with reference to the type of standard equipment which will be available commercially in a year or two.

10-69. Oxygen and Hydrogen in Steel Weld Metal. T. E. Rooney. *Welding,* v. 14, April '46, p. 178-184.

Methods for determination of total oxygen and the form in which it is present in weld metal. Methods for hydrogen determination. Value of these methods in examination of weld metal. Influence of the electrode coating on the type of inclusion obtained and the percentage of hydrogen in the weld is demonstrated by use of the methods outlined.

10-70. The Determination of Cobalt. A. Norman Hixson and Wallace M. McNabb. *Metal Finishing,* v. 44, May '46, p. 208-209.

Method for the determination of cobalt in the presence of iron and nickel, using a photo-electric colorimeter and nitroso-R-salt, which is suitable for certain control work.

10-71. Estimation of Bismuth in Aluminum Alloys. J. H. Bartram and P. J. C. Kent. *Light Metals,* v. 9, May '46, p. 229-231.

Brief observations on the relative merits of gravimetric, spectrographic and colorimetric methods. The Thiourea method is applicable to all aluminum alloys as well as to brasses and bronzes.

10-72. The Spectrograph—Its Use in the Analysis of Metals and Ores. T. C McBurney. *Western Metals,* v. 4, May '46, p. 32-35.

Grating spectrograph and its accessories; how it functions and general methods of procedure; field of the spectrograph—its limitations and possibilities; applications to metal and ore analyses.

10-73. Applications of the Polarograph to Metallurgical Analysis. G. W. C. Milner. *Metallurgia,* v. 33, April '46, p. 321-323.

The determination of trace elements in zinc and zinc alloys. Review of the various methods which have been proposed from time to time. Describes in some detail satisfactory methods for the determination, polarographically, of traces of copper, lead, tin and cadmium in zinc and zinc alloys.

10-74. Electrical Equipment for Spectrographic Analysis. R. S. Coulter. *Materials & Methods,* v. 23, May '46, p. 1298-1302.

Proper electrical equipment can save its own cost many times over by reducing furnace operating charges and giving the laboratory more capacity.

10-75. Spectrographic Analysis of a Magnesium Alloy. Carl Pollard. *Light Metal Age,* v. 5, May '46, p. 17-19.

Method of making spectrographic analysis, including the use and sources of standards, and developing the plates.

10-76. **Oxygen and Hydrogen in Steel Weld Metal.** T. E. Rooney. *Welding,* v. 14, May '46, p. 226-231.

Methods are given for the determination of total oxygen and the form in which it is present in weld metal. Methods also described for hydrogen determination. Value of these methods in examination of weld metal is discussed. Influence of the electrode coating on the type of inclusion obtained and the percentage of hydrogen in the weld is also demonstrated by use of the methods outlined.

10-77. **Routine Analysis of Manganese Bronze.** Edwin K. Babson and Wayne W. Johnson. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, May '46, p. 292-293.

Perchloric and nitric acids are used to dissolve the sample. Nitric acid is removed by fuming with perchloric acid, copper, tin, and lead then being precipitated as sulphides. Tin is determined gravimetrically, copper and lead electrolytically. Iron, having been reduced by hydrogen sulphide, is titrated with permanganate, after which the aluminum is determined by weighing the combined iron and aluminum oxides. Accepted methods are used in the determination of nickel and manganese. Results compare favorably with the certified values of two Bureau of Standards manganese bronze samples.

10-78. **Conductometric Titrations With Organic Reagents. Determination of Copper With Cupferron and Iron With Sulphosalicylic Acid.** J. F. Corwin and H. V. Moyer. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, May '46, p. 302-304.

Use of certain organic analytical reagents in conductometric titrations has been studied and cupferron found suitable for titrating copper in a sulphuric acid solution. Method determines copper rapidly in brass without removing tin and lead. Sulphosalicylic acid and its ammonium salt were used in the volumetric determination of iron. These compounds illustrate the use of organic reagents in titrations in which the change in conductivity is due to the formation of a soluble metallo-organic complex.

10-79. **Determination of Manganese and Chromium in High-Chromium Steels.** H. W. Tomb. *Iron Age,* v. 157, June 13, '46, p. 64.

Using method given, determination can be completed in from 15 to 20 min. as compared to 1 to 2 hr. by the zinc oxide method. Accuracy is considered equal to or greater than that obtained by the zinc oxide method.

10-80. **Photelometric Analysis.** John Parina. *Steel,* v. 118, June 17, '46, p. 110-111, 137, 140.

High accuracy and greater speeds in chemical determinations are virtues of an analytical instrument now finding increased use in metallurgical control laboratories. Light source is not varied nor does instrument indicate transmission value of a solution for total spectral band of light source.

10-81. **The Gravimetric Determination of Tin in Alloys by the Tannin Method.** W. R. Schoeller and H. Holness. *Analyst,* v. 71, May '46, p. 217-220.

Rapid and reliable assay methods are given for the gravimetric determination of tin in white metal (lead-base), brass, bronze, and zinc-base die-casting alloy. A procedure is described by means of which the optimum acidity for the quantitative separation and precipitation of tin by tannin is secured with certainty and ease, no test for complete precipitation being required.

10-82. The Determination of Selenium in Copper Mattes. W. B. Pollard. *Analyst,* v. 71, May '46, p. 221-223.

Sample is put into solution by means of a caustic fusion. Selenium is precipitated by stannous chloride and purified by a second precipitation with sulphur dioxide. After dissolving and oxidizing with bromine and hydrobromic acid, excess bromine is removed by the addition of sodium salicylate and the determination is finished with a thiosulphate titration. 8 ref.

10-83. Detection of Palladium Using Pararosaniline Hydrochloride. A Spot Test Procedure. P. W. West and Edward S. Amis. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, June '46, p. 400-402.

The reaction between palladous chloride and p-fuchsin has been studied. P-fuchsin reacts with palladous chloride at a mol ratio of 2 to 3, apparently with the formation of a double salt. A spot test is proposed which is sensitive to 0.01 microgram of palladium at a limiting concentration of 1 part in 750,000. The reaction is highly selective.

10-84. Routine Spectrographic Analysis of Cast Iron. J. E. Hurst and R. V. Riley. *Iron and Steel Institute Advance Copy,* June '46, 12 p.

A method for the routine spectrographic analysis of cast iron has been used for over a year. The spectrographic technique is found to be ideal for the rapid and accurate analysis of a variety of plain and alloy cast irons for all elements except carbon, sulphur and phosphorus.

10-85. Microquantitative Analysis of Sodium and Potassium. (Continued.) F. Burton. *Metallurgia,* v. 34, June '46, p. 105-107.

Reagents and methods which are of importance.

10-86. Effect of Gaseous Elements on Metals. *Canadian Metals & Metallurgical Industries,* v. 9, July '46, p. 41.

Concerned primarily with the modifications required for the application of the vacuum fusion method to a number of nonferrous metals and alloys. (Abstract of paper for Institute of Metals.)

10-87. Metallurgical Analysis. James Sanders. *Iron and Steel,* v. 19, July '46, p. 423-425.

Review of the commonly used drying agents: calcium chloride; boron trioxide; concentrated sulphuric acid; phosphorus pentoxide; magnesium perchlorate; silica-gel. Some examples cited.

10-88. Spectrographic Analysis of Zinc-Base Alloys. Leslie Larrieu. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, July '46, p. 403-407.

A rapid and accurate spark spectrochemical system in-

corporating the use of the ammonium chloride-packed electrode and the flat disk self-electrode. Commercial high-voltage spark source unit with extra inductance is used for excitation of flat disk samples on a Petrey spark stand. Grating spectrograph is employed. Comparator-densitometers are used for transmission measurements, and conversion to intensity ratios is made on calculating boards. System provides for simultaneous evaluation of all zinc alloy constituents and impurities quantitatively on one spectrogram

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10-89. **Systematic Polarographic Metal Analysis.** James J. Lingane. *Industrial and Engineering Chemistry (Analytical Edition)*, v. 18, July '46, p. 429-432.

Procedures are described for determining tin, lead, nickel, and zinc in copper-base alloys. Other minor elements such as antimony, bismuth, iron and manganese do not interfere, and two samples suffice for all four determinations. Analyses can be completed in about 25 hr. Results obtained with several representative Bureau of Standards copper-base alloys agreed very well with accepted values. 17 ref.

10-90. **Determination of Copper in Cast Iron and Steels With Quinaldic Acid.** John F. Flagg and Don W. Vanas. *Industrial and Engineering Chemistry (Analytical Edition)*, v. 18, July '46, p. 436-438.

Method of Zan'ko and Butenko for the determination of copper in steel by precipitating with quinaldic acid has been investigated and extensively modified. Satisfactory results are obtained only after a reprecipitation of the copper quinaldate. Speed of the method may be increased by making a preliminary separation of copper by internal electrolysis, using an aluminum anode. Spectrographic studies showed precipitates to be of sufficient purity for reliable results. Method, as applied to Bureau of Standards steels, gave an accuracy of about 2 to 3% on samples containing 0.1% or more of copper, but less at lower percentages of copper. Precision is about the same as the accuracy. 20 ref.

10-91. **The Determination of Metallics in Spontaneously Inflammable Magnesium Dust.** J. A. Anderson. *Analyst*, v. 71, June '46, p. 282-286.

Gasometric method for the determination of metallics. Details of a sampling device given.

10-92. **High Speed Spectrography. Part I.** Louis E. Owen. *Iron Age*, v. 158, Aug. 8, '46, p. 50-53.

Detailed description of modifications made to commercial spectrographic equipment in order to adapt it for high speed routine control analyses. Changes made to the safety hood, the spark source unit and the spectrograph camera.

10-93. **High Speed Spectrography. Part II.** Louis E. Owen. *Iron Age*, v. 158, Aug. 15, '46, p. 61-64.

Modification of standard spectrographic equipment to adapt it for high speed routine analysis. Components covered are the masking device, the photographic timer, the microdensitometer, and the calculator.

10-94. Spectrographic Determination of Boron in Steel. Charles H. Corliss and Bourdon F. Scribner. *Journal of Research of the National Bureau of Standards,* v. 36, April '46, p. 351-364.

Spectrographic determination of small amounts of boron in thin steel rods and in massive pieces of steel was investigated by using several types of arc-like discharges. Sensitivity and accuracy in determining boron were found to be affected by variations in the rate of cooling of the electrodes. Determinations as low as 0.0001% of boron are made with a direct current arc to which sodium is added to suppress an interfering Fe 11 line. In the course of the investigation, a series of six boron steels in two sizes, 7/32 and ½-in. rods, were issued as National Bureau of Standards standard samples covering the range 0.0006 to 0.019% of boron.

10-95. Identification of Ferro-Alloys. Thomas C. Cunningham. *Blast Furnace and Steel Plant,* v. 34, Aug. '46, p. 1003-1004.

Various tests outlined for the identification of ferrosilicon grades, silicomanganese, ferrovanadium, ferrochromium, ferroboron.

10-96. Colorimetric Determination of Cobalt in Metallurgical Products with Nitroso R. Salt. R. S. Young, E. T. Pinkney, and R. Dick. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Aug. '46, p. 474-476.

A modification is described for the determination of small quantities of this element in metallurgical products and similar materials. Results compare very favorably in accuracy and precision with those obtained by the longer standard gravimetric procedures, and the recovery of added cobalt is complete.

10-97. Nomographic Procedure for a Two-Component Colored System. Ernest A. Brown. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Aug. '46, p. 493-495.

Graphical procedure is described for the calibration of a filter-type electrophotometer for a mixed-color system by measuring the relative absorption of two wave lengths. Simplified method is described for the construction of a nomograph in terms of electrophotometer scale readings. Procedure is applied to the mixed-color dithizone method for copper in a nickel plating bath.

10-98. Differential Reduction of Iron and Tin. A. C. Simon, Patricia S. Miller, J. C. Edwards and F. B. Clardy. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Aug. '46, p. 496-498.

Method suitable for routine analysis for the titrimetric determination of iron and tin. Method is suitable for bronze and other copper alloys containing less than 1% antimony.

10-99. The Application in Routine Chemical Laboratories of the Alcoholic Iodine Method for the Separation and Analysis of the Oxides in Steel. B. Rogers. *Metallurgia,* v. 34, July '46, p. 163-165.

Residues obtained from rimming steels by alcoholic io-

dine extraction methods normally weigh 6 to 10 mg. Very reliable procedures for the analyses of the residue must be used to give satisfaction. Scheme of analysis is proposed. Alternative procedures are suggested for obtaining information on the mineralogical formation of the oxides.

10-100. **X-Ray Analysis.** *Metal Industry,* v. 69, Aug. 9, '46, p. 119-120.

Concludes papers read at the international conference on X-ray analysis, organized by the Institute of Physics. Electronic radiography; metal physics; American developments; electron diffraction; foreign reports.

10-101. **Routine Analysis of Aluminum Alloys by Colorimetric Methods.** D. F. Phillips. *Aluminum and Magnesium,* v. 2, Aug. '46, p. 14-17.

Development of colorimetric technique; Spekker absorptiometer; advantages of colorimetric methods.

10-102. **Routine Spectrographic Analysis of Cast Iron.** J. E. Hurst and R. V. Riley. *Canadian Metals & Metallurgical Industries,* v. 9, Aug. '46, p. 23-29.

Ideal for the rapid and accurate analysis of a variety of plain and alloy cast irons for all elements except carbon, sulphur, and phosphorus. Method in use, with modifications, is similar to the flat surface technique used by Barker for steel.

10-103. **The Determination of Phosphorus in Steel Containing Titanium and Arsenic.** A. T. Etheridge and D. G. Higgs. *Analyst,* v. 71, July '46, p. 316-317.

Method is satisfactory for steels containing up to 3% titanium.

10-104. **The Determination of Small Amounts of Aluminum in Steel.** F. W. Box. *Analyst,* v. 71, July '46, p. 317-319.

Improved method is described applicable to all types of steel with the exception of 18-8 stainless, which has not yet been tried.

10-105. **X-Ray Diffraction as an Analytical Tool.** David Goodman. *Iron Age,* v. 158, Sept. 19, '46, p. 55-58.

Use of X-ray diffraction as an analytical tool has been integrated into the entire analytical section of the Armour Research Foundation. What can be accomplished in the way of chemical determinations through the application of X-ray is discussed.

10-106. **A General-Purpose Source Unit for the Spectrographic Analysis of Metals and Alloys.** A. Walsh. *Bulletin of the British Non-Ferrous Metals Research Association,* no. 201, March '46, p. 60-80.

A new source unit provides a simple condensed spark, a low-voltage d.c. arc and, by using a triggered low-voltage discharge, a whole series of excitation conditions intermediate between those prevailing in the conventional spark and arc. Experiments on aluminum-base, zinc-base, and lead-base alloys indicate that the accuracy obtainable is higher than is possible when using a simple condensed spark. Circuit diagram is shown and details of the various components are given.

10-107. Fluorometric Determination of Aluminum in Steels, Bronzes, and Minerals. Alfred Weissler and Charles E. White. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Sept. '46, p. 530-534.

Rapid fluorometric method is described for the quantitative determination of from 0.001% to somewhat over 0.1% of aluminum in steels, bronzes, and minerals. Necessity for special microtechnique is avoided by the use of aliquots of a macrosample; sensitivity is better than 1 part in 100,000,000.

10-108. Volumetric Determination of Magnesium in Magnesium Carbonate Ores. Loring R. Williams. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Sept. '46, p. 542-544.

Method involves removal of most of the calcium as the sulphate, precipitation of magnesium hydroxide with excess standard alkali, and titration of the excess with a standard acid. Gives results comparable with those obtained with the conventional gravimetric pyrophosphate method and does not require as much time.

10-109. Electrolytic Detection of Small Amounts of Lead in Brass or Zinc. *Nature,* v. 158, Aug. 31, '46, p. 307-309.

Lead may be detected and identified in brass or zinc by making use of the local cell set up between the lead and the ground-mass. After electropolishing a 70-30 brass containing 0.1% Pb, the lead particles were plainly distinguishable from other inclusions at 1000X because of the formation of a characteristic "ring" around them.

10-110. Polarography. L. Sanderson. *Chemical Age,* v. 55, Sept. 7. '46, p. 289-292.

Discusses theory of electrode polarization and shows how Heyrovsky's dropping mercury electrode can be used for electrochemical analysis. Description of a novel method which uses a superposition of direct and alternating voltages.

10-112. Semiquantitative Tests for Moly in Steel. W. E. Thrun and C. R. Heidbrink. *Iron Age,* v. 158, Oct. 3, '46, p. 41.

Modifications to the thiocyanate and the potassium ethylxanthate methods for detecting and roughly estimating the molybdenum content in steels and irons.

10-113. Polarographic Analysis of Zinc in Aluminum Alloys. F. R. De Paola. *Iron Age,* v. 158, Oct. 3, '46, p. 36-40.

Detailed description of the material and apparatus used; step-by-step description outlining the procedure to be followed in the mathematical solution.

10-114. The Determination of Oxide Cobalt. R. S. Young, A. J. Hall, and H. L. Talbot. *Metals Technology,* v. 13, Sept. '46, T.P. 2050, 5 p.

Procedure for the determination of oxidized cobalt in the presence of cobalt sulphide in ores and concentrator products. Method is based on the selective solvent action of dilute H_2SO_4 or HCl, in the presence of hydrofluoric

acid, and sulphurous acid, on oxide cobalt minerals. Method may be adapted for the differentiation of oxidized and sulphide forms of other elements.

10-115. **A Method of Quantitative Spectrochemical Analysis Based on Line Widths.** Pierre Coheur. *Journal of the Optical Society of America,* v. 36, Sept. '46, p. 498-500.

Method is practical and accurate, independent of development conditions or exposure time and may be applied to cases where customary techniques fail.

10-116. **The Use of Heterochromous Lines in Spectrographic Photometry.** S. Levy and O. W. Christine. *Journal of the Optical Society of America,* v. 36, Sept. '46, p. 503-506.

Relationship between the transparencies caused by spectral lines of a large $\Delta\lambda$ as a function of exposure and plate contrast. For a particular case, procedure based upon this relationship is described, permitting the use of lines of a large $\Delta\lambda$ when no other suitable lines are available.

10-117. **Spectrographic Analysis of Special High-Grade Zinc.** A. Y. Bethune and W. W. Schmittroth. *Metals Technology,* v. 13, Sept. '46, T. P. 2066, 13 p.

Spectrographic method for determination of Pb, Fe, Cu, and Cd in special high-grade zinc, using self-electrodes requiring the minimum of preparation, has proven satisfactory for production control and final analysis of very high-purity zinc metal by varying to lower grades of zinc.

10-118. **Some Modern Aids to Spectrochemical Analysis.** B. S. Cooper. *Analyst,* v. 71, Aug. '46, p. 356-361; discussion p. 374.

Developments in light sources, in optical materials, and in energy receivers. 15 ref.

10-119. **Spectrographic Analysis of Rare and High-Purity Materials.** D. M. Smith. *Analyst,* v. 71, Aug. '46, p. 368-373; discussion p. 374-375.

Methods of spectrographic control used in preparation and testing of spectroscopically pure substances. Examples of the type of work include preparation of pure copper, graphite and carbon electrodes and rare earth analysis. Describes identification of impurity lines and excitation sources.

10-120. **An Absorptiometric Method for Magnesium in Zinc-Base Die-Casting Alloys.** F. H. Edwards and A. M. Robinson. *Analyst,* v. 71, Aug. '46, p. 379-381.

Method enables results of comparable accuracy to be obtained in approximately one-third of the time required by gravimetric method. Magnesium figures are not affected by the presence of copper as an alloying element up to 3% or by small amounts of iron, lead, tin and cadmium as impurities.

10-121. **Quick Methods for Identifying Metals.** J. E. Garside. *Iron Age,* v. 158, Oct. 17, '46, p. 58-62.

Review of quick, simple methods of identifying ferrous and nonferrous metals to determine chemical composition and some physical characteristics. Tabular comparisons of reactions of various metals to spot, electrographic, blowpipe, lathe chip and magnet tests.

10-122. **Effect of Reaction Between Mercury and Oxygen Upon Polarographic Waves of Certain Metals at Small Concentrations.** Edgar Reynolds Smith, John Keenan Taylor, and Roberta Evelyn Smith. *Journal of Research of the National Bureau of Standards,* v. 37, Sept. '46, p. 151-152.

Polarographic waves of certain metals, notably of lead, zinc, copper, cobalt, and nickel in dilute neutral solutions, diminish progressively with time in the presence of mercury and air. This behavior is not to be explained by adsorption, as has previously been supposed, but by a reaction between mercury, water, oxygen, and the ions of the metallic salt which, in some instances, precipitates the metal from solution in the form of its hydroxide. Recognition of this reaction and precautions to exclude it are essential for accurate polarographic determinations of small amounts of heavy metals. 16 ref.

10-123. **Distinguishing the Common Aluminum Alloys.** Frank C. Bennett, Jr. *Metal Progress,* v. 50, Oct. '46, p. 659, 661.

Solutions and chemical tests which may be employed without recourse to anodizing. Methods for distinguishing copper in 3S, 11S, 17S, 24S alloys and chromium in 52S, 53S and 61S alloys.

10-124. **Influence of the Nature and Concentration of Supporting Electrolyte on Polarographic Diffusion Current.** O. Collenberg and A. Scholander. *Nature,* v. 158, Sept. 28, '46, p. 450-451.

Studied behavior of diffusion current in supporting electrolytes of high concentration in ten systems. Results indicate that it is necessary to keep the concentration of the electrolyte absolutely constant when carrying out polarographic determinations in electrolytes of high concentration.

10-125. **Colorimetric Determination of Molybdenum in Zinc Cyanide Plating Solutions.** Louis Silverman, Virginia Stewart, and Jane Davies. *Metal Finishing,* v. 44, Oct. '46, p. 426-428.

By method described concentrations of molybdenum as high as three milligrams per hundred milliliters of aqueous solution can be determined. Details of procedure, experimental results and sample calculations.

10-126. **Photocolorimetric Method of Determining Silicon in Hadfield Steel.** A. I. Kokorin and K. D. Vasileva. *Metallurgia,* v. 34, Sept. '46, p. 286-287.

Method in which solution is effected by means of dilute H_2SO_4 and perhydrol is recommended. (From *Zarod. Lab.,* v. 12, 1946, p. 123.)

10-127. **The Spectrographic Analysis of Cartridge Brass.** M. M. White. *Industrial Radiography,* v. 5, Fall '46, p. 27-31.

A spectrographic method for the analysis of lead and iron in cartridge brass is rapid and accurate. Discusses two aspects of the problem of more than usual interest. Preparation of alloy standards in the laboratory and reaction of the lead line to changes in capacity and resistance.

10-128. Applications of the Thermal Conductivity Gas Analyzer. A. J. Bialous and C. A. Hansen, Jr. *General Electric Review,* v. 49, Oct. '46, p. 20-26.

Enumerates the various nonchemical types of gas analyzers and describes the characteristics and applications of the thermal conductivity type of instrument in considerable detail.

10-129. Use of Control Charts in the Analytical Laboratory. Grant Wernimont. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Oct. '46, p. 587-592.

How the control chart procedure of Shewart can be used to simplify statistical analysis of data. Method is illustrated by several examples. 21 ref.

10-130. Determination of Impurities in Electroplating Solutions. IV. Iron in Nickel Plating Baths. Earl J. Serfass, W. S. Levine, G. Frederick Smith, and Frederick Duke. *Monthly Review,* v. 33, Nov. '46, p. 1189-1199.

Development of a rapid, accurate method for the determination of very small amounts of iron in nickel plating baths which also contain appreciable quantities of aluminum, cadmium, copper, lead, manganese, silicon, zinc, calcium, and chromic trioxide (CrO_3). A ferrous o-phenanthroline complex is measured colorimetrically as the last step in the determination. 19 ref.

10-131. Determination of Impurities in Electroplating Solutions. A. E. S. Research Project No. 2. Parts II and III. Earl J. Serfass and W. S. Levine. *Monthly Review,* v. 33, Oct. '46, p. 1073-1087.

Description of the operational technique involved in spectrophotometric work. Method for the determination of lead in nickel plating baths. Lead is separated from interfering ions by extraction with a carbon tetrachloride solution of dithizone in the presence of potassium cyanide. After removal of the excess dithizone with alkaline potassium cyanide, the transmittancy of the solution is measured and the quantity of lead present determined from a calibration curve.

10-132. Light Integrating Exposure Switch for Spectrographic Analysis. H. R. Clayton. *Journal of Scientific Instruments,* v. 23, Oct. '46, p. 233-234.

To assist in obtaining spectrograms of consistent density and to minimize the contribution of personal errors to spectrography, an automatic exposing device has been developed. A pre-sparking period of fixed duration is followed by an exposure period during which the light emitted by the source is automatically extinguished. The unit is versatile and is considerably more accurate than manual operation.

10-133. The History and Present Status of Emission Spectroscopy as Applied to Industry. John Convey. *Metallurgia,* v. 34, Oct. '46, p. 331-334.

Historical foundation of spectroscopy; recognition of characteristic spectra; development of quantitative spectrochemistry. 25 ref.

10-134. The Volumetric Determination of Cobalt. A. J. Hall and R. S. Young. *Chemistry & Industry,* no. 44, Nov. 2, '46, p. 394-395.

Two volumetric methods suitable for analysis of smelter samples. Titrations with potassium cyanide and with potassium ferricyanide, respectively.

10-135. **Spectrochemische Analyse Van Metaallegeringen Met Behulp Van Emissiespectra. (Spectrochemical Analysis of Metal Alloys Using the Emission Spectrum.)** R. Schmidt. *Metalen,* v. 1, Oct. 15, '46, p. 17-22.

Fundamental principles of qualitative and quantitative emission spectrographic analysis. The most convenient light sources with corresponding diagrams of the circuits are indicated.

10-136. **Zur Quantitativen Bestimmung von Wolfram, Molybdan und Vanadium fur sich und neben Eisen mit 8-Oxychinolin. (Quantitative Determination of Tungsten, Molybdenum and Vanadium Alone and in the Presence of Iron Using 8-Oxyquinoline.)** R. Niericker and W. D. Treadwell. *Helvetica Chimica Acta,* v. 29, no. 6, June '46, p. 1472-1483.

Tungstate, molybdate, vanadate, and ferric ion are precipitated as oximes and titrated bromometrically. Two methods for the quantitative conversion of oximes into the corresponding oxides at 480° C. are described. Also, several methods for separation and individual determination of tungstate, molybdate, vanadate, and ferric ion using the differences of solubility of oxime in 2*N* HCl are indicated.

10-137. **On the Detection of Uranium by Potassium Ferrocyanide.** Moritz Kohn. *Chemist Analyst,* v. 35, Sept. '46, p. 52-53.

Oxalic acid, acetates, oxalates, tartrates, and other complex-forming substances interfere in the formation of brown uranyl ferrocyanide, which has been recommended for microchemical detection of uranium and of hydroferrocyanic acid.

10-138. **A Simple Polarographic Procedure for Cadmium Dust and Fumes in Air.** Leslie Silverman. *Chemist Analyst,* v. 35, Sept. '46, p. 53-55.

Rapid, simple polarographic procedure which can be applied to the determination of cadmium dusts and fumes in air or in settled dusts.

10-139. **Rapid Qualitative Methods for Nickel, Chromium and Molybdenum in Low-Alloy Steels.** Rolland L. Mays. *Chemist Analyst,* v. 35, Sept. '46, p. 62-63.

From the standpoints of rapidity, sensitivity, and the quantity of sample required, the procedures described have been found to be eminently satisfactory for a wide range of low-alloy steels.

10-140. **Behavior of Uranyl Solutions in a Mercury Reductor.** Earl R. Caley and L. B. Rogers. *Journal of the American Chemical Society,* v. 68, Nov. '46, p. 2202-2204.

In solutions containing hydrochloric acid in sufficiently high concentration, uranyl ion is almost quantitatively reduced to uranous ion in the mercury reductor. By use of small correction factor this reduction may be applied to the volumetric determination of uranium. The possible interference of uranium should be taken into account when using the mercury reductor for the determination of certain other elements.

10-141. **The Accurate Volumetric Determination of Zinc and Nickel Using Diphenylcarbazone as Indicator.** B. S. Evans. *Analyst,* v. 71, Oct. '46, p. 455-459.

Methods for volumetric determination of zinc and of nickel by a new process, each method being available for very low quantities and for a wide range of sample weights; volumetric determination, without separation, of zinc in nickel plating baths, and detection of an excess of zinc over a given amount in nickel plating baths.

10-142. **A Method for the Determination of Zinc in Copper Alloys and for the Separation of Zinc From Cadmium.** B. S. Evans. *Analyst,* v. 71, Oct. '46, p. 460-464.

Method based on a study of the behavior of the double cyanide of certain metals in presence of sulphide ion has been applied to the determination of zinc in copper alloys. An improved procedure permits complete separation of zinc from cadmium in one precipitation.

10-143. **Spot Tests for the Detection of Alloying Elements in Aluminum and Magnesium-Base Alloys.** B. S. Evans and D. G. Higgs. *Analyst,* v. 71, Oct. '46, p. 464-474.

Procedures described for copper, magnesium, zinc, manganese, tin, iron, nickel, titanium, antimony, bismuth, lead and chromium.

10-144. **The Rapid Determination of Small Quantities of Nickel With Dithizone.** R. S. Young, E. H. Strickland and A. Leibowitz. *Analyst,* v. 71, Oct. '46, p. 474-476.

Rapid procedure for determination of very small quantities of nickel is applicable to a wide variety of materials. It is based on isolation of nickel with dimethygloyoxime, its extraction with chloroform, transference to dilute acid solution, and final titration in alkaline solution with a standard solution of dithizone.

10-145. **The Determination of Lead in Copper, Nickel and Cobalt by Dithizone.** R. S. Young and A. Leibowitz. *Analyst,* v. 71, Oct. '46, p. 477-479.

Lead, together with arsenic, antimony, and bismuth, is collected by ferric hydroxide. Iron is removed by an ether extraction. Lead and bismuth are extracted by dithizone from an alkaline cyanide medium, and these metals are transferred to a dilute acid phase by shaking with nitric acid. Bismuth is then extracted at pH 2 to 3. Finally lead is titrated with dithizone in a solution buffered at pH 8.

10-146. **The Separation of Cobalt From Nickel and the Colorimetric Determination of Nickel.** A. J. Hall and R. S. Young. *Analyst,* v. 71, Oct. '46, p. 479-482.

Method in which cobalt is complexed with ammonium thiocyanate and extracted by means of a mixture of amyl alcohol and ether. Provided the amount of cobalt present is not too large (0.2 g. at the most) it may be extracted quickly and the presence of excess of thiocyanate does not interfere with the nickel determination.

10-147. **Solubility of Magnesium Ammonium Phosphate Hexahydrate.** R. F. Uncles and G. B. L. Smith. *Industrial and Engineering Chemistry (Analytical Edition),* v. 18, Nov. 8, '46, p. 699-702.

Determinations of the solubility of magnesium ammonium phosphate in various concentrations of aqueous and ammoniacal salt solutions likely to be encountered in analytical practice were made. It was found that, if the recommended gravimetric procedure for magnesium was used, the solubility error was negligible. 21 ref.

10-148. **Determination of Chromium by Oxidation With Perchloric Acid.** Sigmund Schuldiner and Frederick B. Clardy. *Industrial and Engineering Chemistry (Analytical Edition)*, v. 18, Nov. '46, p. 728-729.

Modifications of conventional procedures which have been satisfactorily used for over two years.

10-149. **Interference in Thin Parallel Surfaced Transparent Plates as a Source of Error in Spectroquantitative Analysis.** Joshua Stern. *Journal of the Optical Society of America*, v. 36, Nov. '46, p. 654-658.

Analyzes the errors derivable from these interference effects. Simplest and most practicable method of eliminating the errors is to avoid the use of parallel-faced plates. This can be done in the case of slit covers, without losing the protection provided, by using a lens instead of a flat plate as the cover.

10-150. **Spectrographic Determination of Small Aluminum Contents in Ordinary and Special Steels.** René Castro. *Metal Treatment*, v. 13, Autumn '46, p. 182-196.

Speed of the analysis is much greater than that of chemical analysis. A method of analyzing the dissolved aluminum, using hydrochloric acid solutions with a low iron content, has been proposed. Results of these tests have been compared with work so far published in technical literature. (Translation of a paper presented in Paris in January 1946 by the Group for the Advancement of Spectrographic Methods of Analysis of Metallic Products.)

10-151. **Spot Testing for Aluminum.** W. E. Thrun and C. R. Heidbrink. *Iron Age*, v. 158, Nov. 28, '46, p. 68-69.

Reagent recommended for semiquantitative spot testing of aluminum in steel and iron is eriochromecyanine. It is not, however, too sensitive to the presence of iron, which may be present in small amounts in the ferric state.

10-152. **Electronic Metal Analyzer.** S. R. Winters. *Radio News*, v. 36, Nov. '46, p. 28-29, 164-165.

Newly developed direct-reading spectrometer designed by Dow Chemical Co. makes possible analysis of a maximum of 14 different elements found in industrial alloys. Process requires only 40 sec.

10-153. **The Spectrographic Determination of Trace Elements in the Cathode Layer Arc by the Variable Internal Standard Method.** R. O. Scott. *Journal of the Society of Chemical Industry*, v. 65, Oct. '46, p. 291-297.

Use of iron as the variable internal standard for determination of trace elements in the cathode layer arc, when the iron varies from 2% to 100% Fe_2O_3. Two shortened methods for derivation of working curves. 24 ref.

10-154. **Method for Polarographic Determination of Traces of Copper in Aluminum Alloys.** I. B. Mizetzkaya. *Journal of Applied Chemistry* (U.S.S.R.), v. 19, no. 4, '46, 400-403. (In Russian.)

Method described permits determination of 0.01 to 0.1% Cu with relative precision of 10%, without preliminary separation of copper from the other components of the alloy.

10-155. **Interaction of Columbium and Tantalum With Polyphenols.** U. V. Kariaku and P. M. Telezhnikova. *Journal of Applied Chemistry* (U.S.S.R.), v. 19, no. 4, '46, p. 435-439. (In Russian.)

Interaction of 22 different aromatic compounds with Cb, Ta and Ti, in various media and at different temperatures. Results indicate the possibility of using some of these compounds as reagents for the colorimetric determination of Cb, Ta and Ti.

10-156. **Identification of Plated Coatings.** George Black and Jack Sinner. *Metal Finishing,* v. 44, Dec. '46, p. 529-530.

Simplification of identification tests on various deposits is proposed. Spot test methods are recommended, thereby reducing elaborate laboratory methods. Charts summarize the techniques.

10-157. **Cast Iron.** J. E. Hurst. *Iron and Steel,* v 19, Nov. 21, '46, p. 709-714.

Standardized procedure for spectrographic analysis which is capable under routine conditions of giving an accuracy of better than $\pm 2.5\%$ of the content of the element being determined.

SECTION XI

LABORATORY APPARATUS, INSTRUMENTS

11-1. Thickness Measurement. *Iron and Steel,* v. 18, Nov. '45, p. 486.

Supersonic contact instrument; apparatus comprises a simple variable frequency oscillator and a quartz crystal.

11-2. Sorting Metals by Tribo-Electrification. Antony Doscheck. *Steel,* v. 117, Dec. 24, '45, pp. 106, 109, 110.

Centuries old electrostatic phenomenon engineered to meet modern identification needs.

11-3. Electron Diffraction Instrument. C. H. Bachman. *General Electric Review,* v. 48, Nov. '45, pp. 7-11.

New commercially available G-E electron diffraction instrument. Occupies floor space 2x4 ft. Has magnetic focusing and auxiliary electron gun which makes it possible to obtain patterns of non-conducting specimens. Patterns can be obtained by transmission or reflections. Fundamentals and applications of electron diffraction described.

11-4. Hermetically Sealed Instruments. O. G. McAninch and L. F. Perott. *General Electric Review,* v. 48, Nov. '45, pp. 28-31.

How glass-to-metal sealing affords a maximum protection against extreme humidities and temperatures of tropics and yet permits on-the-spot servicing.

11-5. Roentgen-Ray Tubes. W. D. Coolidge and E. E. Charlton. *General Electric Review,* v. 48, Nov. '45, pp. 36-41, 44-51.

Reviews development from Roentgen to modern tubes. Discusses gas tubes and their limitations, hot-cathode gas tube, hot-cathode high vacuum tube, field current tube. Advantages of the usual hot-cathode high vacuum type; current and quality control; directionality, efficiency of X-ray production; target design; focal spot; rotating target. Tubes for fluoroscopy, therapy, diffraction discussed.

11-6. The Comparator—Modern Gaging Instrument. *Screw Machine Engineering,* v. 7, Dec. '45, pp. 47-56.

Measurement by interception of light beams; control of quality in manufacture; setting up control; measurement

and comparison; horizontal measurement; vertical measurement; angle measurement; comparator as a companion tool to thread grinding and allied threading processes; universal screw stage; inspection of internal threads; inspection of taper threads; forming tool profile inspection.

11-7. **The Fundamentals of Electron Tubes, Part IV.** Ralph B. Immel. *Power Plant Engineering,* v. 49, Nov. '45, pp. 113-114.

Comparison of vacuum and gaseous tubes using thermionic emission. Effect of a small amount of gas in a vacuum tube; principle of the two-element gaseous tube; Thyratron or three-element gaseous tube; the fluorescent lamp.

11-8. **Electric Gaging Methods for Strain, Movement, Pressure and Vibration, XVI.** Howard C. Roberts. *Instruments,* v. 18, Dec. '45, pp. 882-889, 912-914, 916-918, 920.

Basic requirements for power supplies discussed.

11-9. **Thrust-Torque Tester.** *Steel,* v. 117, Dec. 31, '45, p. 74.

New instrument employs compressed air to counterbalance force under test.

11-10. **Electronics—Tube Development.** Clark E. Jackson. *Modern Metals,* v. 1, Dec. '45, pp. 18-21.

Explains physical structure and operation of electronic tubes and possibilities of their use in metal industry.

11-11. **The Upright Type of Microscope in Metallography.** J. R. Vilella. *Metal Progress,* v. 49, Jan. '46, pp. 113-116.

Cites its advantages and conveniences as compared with the inverted type. Photomicrographs show that with a properly built upright microscope equipped with a good vertical illuminator, results are obtainable, both in visual examination and photomicrography, which approximate those of the finest inverted microscope.

11-12. **Electronic Measurement, Analysis and Inspection.** H.L.H. *Machinery (London),* v. 67, Dec. 27, '45, p. 729-732.

Function of the photo-tube; typical application of photo-controllers; pyrometer applications; continuous and accurate temperature regulation.

11-13. **Checking Surface Finish.** *Steel,* v. 118, Jan. 28, '46, p. 115, 158.

Instrument measures surface wear proportional to percentage of interrupted area lying in same plane.

11-14. **What You Should Know About Industrial Electronics, III.** *American Machinist,* v. 90, Jan. 31, '46, p. 88.

What electronic tubes can do.

11-15. **Removable Wax Disks Salvage Polishing Laps.** John W. Weeton. *American Machinist,* v. 90, Jan. 31, '46, p. 105.

Convenience and economy in preparing metal specimens for micro-examination result from the simplicity of this wax-lap assembly.

11-16. **Microscope and Camera in the Study of Foundry Sand.** A. C. Den Breejen. *American Foundryman,* v. 9, Feb. '46, p. 20-26.

Simple, inexpensive tools for study of a basic metal—casting material, foundry sand. Equipment; how the mi-

croscope works; preparation of sample and focusing; appearance of sand grains; construction of the photographic unit. 11 ref.

11-17. Applications of Metallic Shadow-Casting to Microscopy. Robley C. Williams and Ralph W. G. Wyckoff. *Journal of Applied Physics,* v. 17, Jan. '46, p. 23-33.

Factors which determine image contrast in optical and electron micrographs are discussed in relation to new metal shadow-casting technique whereby contrast of images is greatly increased by depositing obliquely thin film of metal on microscope preparations. Further advantages of use of shadow-casting are described, and estimate is made of lower limit of size of objects which should be observable by shadow-casting. Examples are given and illustrations are shown of applications of this technique to electron micrography of particles of macro-molecular dimensions, of replicas of such particles, and of surface replicas prepared in several ways.

11-18. A Modified Kelvin Method for Measuring Contact Potential Differences. W. E. Meyerhof and P. H. Miller, Jr. *Review of Scientific Instruments,* v. 17, Jan. '46, p. 15-17.

Simple, rugged, and reliable apparatus for measurement of contact potential differences (abbreviated c.p.d.) by modified Kelvin method. Null circuit using 6F5 as electrometer tube has a sensitivity of 0.5 cm. scope deflection per mv. of c.p.d. per sq. cm. sample area, which permits the c.p.d. to be determined to 1/100 volt for samples with surface areas as small as 2 sq. mm. Apparatus was developed for study of surface characteristics of metals.

11-19. Geiger Counter Used in Powder Metallurgy. E. S. Kopecki. *Iron Age,* v. 157, Feb. 28, '46, p. 48-51.

Qualitative and quantitative analyses are accomplished in much less time than with other methods and instruments now in common usage, mainly due to the fact that X-ray intensities and diffraction angles can be measured directly, without intermediate photographic steps; deals with the use of the spectrometer in the field of powder metallurgy.

11-20. Micrographic Study of Sections of Anodic Oxidation Film on Aluminium-Magnesium Alloys. Paul Lacombe and Louis Beaujard. *Metal Treatment,* v. 12, Winter, '46, p. 223-232.

New method for examining and measuring thicknesses of anodic oxidation film, demonstrating that the profile of the film in contact with the metal differs according to the structure of the alloy. New method of micrographic treatment is suggested, permitting homogeneous and heterogeneous alloys to be clearly distinguished. Electrolytic polishing is recommended for obtaining perfect surfaces in preparation for oxidation tests. 13 ref.

11-21. Etching for the Microscope. Part I. Iron and Steel. C. A. E. Wilkins. *Metal Treatment,* v. 12, Winter, '46, p. 233-241.

Purposes of etching and methods employed. Etching of cast iron. Table gives heat tints on gray cast iron at various temperatures; effect of etching on constituents of

cast iron; etching of steel, including high alloy steels of the stainless and high speed types and identification of carbides occurring in steels by electrolytic etching. 9 ref.

11-22. **New Developments in the Study of Surface Chemistry.** Earl A. Gulbransen. *Metal Progress,* v. 49, March '46, p. 553-559.

Electron microscope, the electron diffraction camera and the vacuum microbalance; particular application of each.

11-23. **A Lens to Supplant the Spectrograph Slit.** Carl M. King. *Journal of the Optical Society of America,* v. 36, March '46, p. 164-168.

The advantages that may be claimed for the pseudo slit are *(a)* simplicity of manufacture; *(b)* greater durability and ease of maintenance for extremely narrow lines; *(c)* maximum light efficiency at all times.

11-24. **A Photo-Electric Spectrophotometer for the Schumann Region.** Elbert P. Little. *Journal of the Optical Society of America,* v. 36, March '46, p. 168-171.

A photo-electric spectrophotometer for measuring reflectances and transmittances of polished specimens at various angles of incidence has been developed for use in the Schumann region. Such measurements of reflectance at two or more angles of incidence permit the calculation of the index of absorption and the index of refraction of materials opaque to light of these wave lengths.

11-25. **A Glossmeter for Smoothness Comparisons of Machine-Finished Surfaces.** Richard S. Hunter. *Journal of the Optical Society of America,* v. 36, March '46, p. 178-181.

Since shininess is one indication of surface smoothness, a photo-electric glossmeter was developed for possible use as a production-inspection device for determining the roughness of machine-finished surfaces between 100 and 500 micro-inches root mean square deviation from mean surface.

11-26. **Optical Methods for the Examination of Surfaces.** B. Frischmuth. *Industrial Diamond Review,* v. 6, March '46, p. 70-74.

Optical methods used at present for the examination of surface finish, particularly the Schmaltz "light-slit" method. Adapter is described which enables method to be carried out with the aid of a standard inverted type metallurgical microscope. Usefulness of adapter is illustrated in a number of photomicrographs, obtained with various types of surfaces. (Translated from *Schweizer Archiv fuer angew. Wissenschaft und Technik,* v. 11, Sept. '45, p. 262-269.)

11-27. **Instrument Gage.** *Compressed Air Magazine,* v. 51, April '46, p. 114.

Measures thickness of metal and other sheet stock; inspects bonds between plies of laminated materials such as wood, plastic, glass cloth. Device operates on pressure principle and consists of a cup-shaped shell with a transparent top wall and a rubber gasket around the lower edge.

11-28. **Electric Strain Gages Aid Machine Design.** V. E. Hillman. *Iron Age,* v. 157, April 11, '46, p. 50-53.

Principle of operation and method of using these gages, as well as the indicating equipment necessary for observing the results.

11-29. **Surface Finish of Reduction Gear Teeth.** J. A. Davies. *Journal of the American Society of Naval Engineers,* v. 58, Feb. '46, p. 16-20.

Use of Faxfilms for inspection of gear tooth surfaces. Process can be and has been used on any surface the condition of which is subject to question.

11-30. **Measurement of Surface Roughness.** C. J. Posey. *Mechanical Engineering,* v. 68, April '46, p. 305-306, 338.

Method of measuring statistical similarity of surfaces.

11-31. **Test Methods for Predicting Diaphragm Performance.** H. G. Williams. *Instrument Maker,* v. 14, March '46, p. 24, 26, 28.

Dead-weight center loading with deflections measured by electronic micrometer is the test method developed at Instrument Specialties.

11-32. **Further Improvement in the Resolving Power of the Electron Microscope.** James Hillier. *Journal of Applied Physics,* v. 17, April '46, p. 307-309.

Recent improvements in R. C. A. electron microscope have made it possible to obtain in practice the theoretical limiting resolving power of 5 to 10 Ångstroms.

11-33. **Preparation of Electron Microscope Specimens for Determination of Particle Size Distribution in Aqueous Suspensions.** A. M. Cravath, A. E. Smith, J. R. Vinograd and J. N. Wilson. *Journal of Applied Physics,* v. 17, April '46, p. 309-311.

Small droplets of the suspension to be examined are deposited from a mist upon a specimen film whose surface has been treated to promote wetting by the droplets. Procedure makes the entire residue left by a whole droplet available for examination and promotes uniform dispersion of the deposit.

11-34. **A Universal Metallographic Polishing Procedure.** William C. Coons. *Metal Progress,* v. 49, May '46, p. 956-959.

Essential precautions; materials used; procedure; results. Includes photomicrographs of iron, steel, and alloys of aluminum, copper, and magnesium polished by method outlined.

11-35. **The Geiger-Muller X-Ray Spectrometer.** F. G. Firth. *Industrial Radiography,* v. 4, Spring '46, p. 17-21, 47.

Analyzer is on a radial arm, with the specimen as center and scans an arc that can be read off on a graduated goniometer scale as twice the Bragg angle. Analyzer sensitive element is a special Geiger tube that is coupled to suitable circuits so that the intensity of received maxima is recorded on a strip chart pen recorder in a linear fashion. Instrument has been applied to a large number of problems in a wide variety of industries.

11-36. **Finish Testing Equipment. No. V. Wet Film Gage.** *Organic Finishing,* v. 7, May '46, p. 41.

Film gage by means of which thickness of wet films of

finishing materials may be quickly and accurately determined. Of particular service in measuring and controlling the thickness of coatings applied by spray gun and roller coater.

11-37. Thickness Measurement of Thin Coatings by X-Ray Absorption. H. Friedman and L. S. Birks. *Review of Scientific Instruments,* v. 17, March '46, p. 99-101.

Method is described for determining thickness of thin coatings on crystalline bases by means of X-ray source and Geiger counter, both situated on same side of coating. X-rays pass through the coating and are reflected at Bragg diffraction angle from base, back to counter, their intensity being reduced by absorption due to double transmission through coating. Thickness of coating is computed from measured absorption. Method is applicable to coating thicknesses in range 0.00001 to 0.01 cm.

11-38. Thermocouple Vacuum Gage. H. Robinson and M. C. Flanagan. *General Electric Review,* v. 49, May '46, p. 42-44.

Simple direct-reading gage for pressures in 1 to 200-micron range. Indicating unit may be portable, or panel-mounted with interconnections for giving indications at a distance.

11-39. The Microscope in Metallurgy. Part I. General Considerations. L. Sanderson. *Chemical Age,* v. 54, May 4, '46, p. 497-500.

A fundamental study of the microscope with discussion of lenses, eyepieces, and types of illumination.

11-40. Microscopical Examination of Metals and Alloys, With Special Reference to Electrolytic Etching and Photomicrography in Color. K. J. B. Wolfe. *Metal Treatment,* v. 8, Spring, '46, p. 25-40.

Electrolytic etching has proved of great value to the metallurgist in obtaining consistently good micrographs from metals and alloys that are considered to be difficult to etch by normal chemical means. These include aluminum, copper, and nickel-base alloys. Reagent produced for nickel-base alloys also found satisfactory for austenitic chromium-nickel steels. An electrolytic etching outfit is described that is suitable for quick and accurate work. Typical photomicrographs obtained by this method are shown. Methods also given for the production of transparencies—suitable for lantern slides—and photomicrographs of metals and alloys in natural colors.

11-41. Etching for the Microscope. Part II. Nonferrous Metals and Alloys. C. A. E. Wilkins. *Metal Treatment,* v. 8, Spring, '46, p. 41-52.

Attempt to simplify enormous range of etching solutions and to systematize and summarize most useful reagents for any particular metal or alloy. Range covered has included most of the mixtures of steel and nonferrous metals together with varied alloys of the monel metal and cemented carbide type.

11-42. A Simple, Fast Metallographic Polishing Method. R. B. McCauley, Jr. and L. F. Mondolfo. *Materials & Methods,* v. 23, June '46, p. 1583-1586.

Samples of pure metals or their alloys can be prepared for examination in a few minutes by unskilled workers with ordinary cloth buffing wheels.

11-43. **The Microscope in Metallurgy, Part II.** L. Sanderson. *Chemical Age,* v. 54, June 1, '46, p. 612-614.

Techniques used in microscopic examination of metals at high and low temperatures. The scanning, replica and diffraction techniques used in electron microscope work.

11-44. **Flow-Rate Metering Enters a New Technical Era.** Kermit Fischer. *Instruments,* v. 19, June '46, p. 331-334.

In the variable-area type flow meter (Rotameter) "inherent" automatic pressure and temperature compensation without recourse to separate measuring elements can be obtained with amazing simplicity. Electronic systems for small-flow control; viscosity measurements.

11-45. **Applications of Multiple-Printing Recorders.** A. H. Jordan and Charles A. Vogelsang. *Instruments,* v. 19, June '46, p. 339-341.

Multiple record printing, already a fount of information in present development of new processes and for accurate information with respect to the quality of a product, is actually a gage for knowing exactly what is occurring at any one of several or at any one given point in a process.

11-46. **Scientific Glass Blowing and Laboratory Techniques. Part VIII. Glass-to-Metal Seals.** William E. Barr and Victor J. Anhorn. *Instruments,* v. 19, June '46, p. 344-356.

Fundamental principles involved in glass-to-metal seals; platinum; tungsten; molybdenum. 14 ref.

11-47. **Rapid and Direct Measurement of Vapor Pressure of Liquid Metals.** A. H. Weber and Sister Gonzaga Platenberg. *Physical Review,* v. 69, no. 11 and 12, June 1 and 15, '46, p. 649-651.

Rapid, direct method for determining vapor pressure of liquid metals by measuring force of impact of evaporated particles with vacuum microbalance. Vapor pressure of bismuth obtained by this method in preliminary experiment is found to be in fairly good agreement with other measurements.

11-48. **Finish Testing Equipment. No. VII.** *Organic Finishing,* v. 7, July '46, p. 33, 36.

Instrument illustrated is used to measure the thickness of dried or baked films of organic finishing materials on magnetic iron or steel. Measurement is made from one side of the film without marking the surface. Standard scale range is 0.0001 to 0.100 in. Scale range which is extended to 0.300 in. is available.

11-49. **Metallographic Etchant to Distinguish Oxidation in Steel.** A. M. Hall. *Metal Progress,* v. 50, July '46, p. 92-96.

Use of an alkaline solution of potassium permanganate and potassium dichromate to reveal weld-line oxidation. Preparation of the reagent; use of the etchant; microstructural features revealed.

11-50. **Some Principles and Methods of Surface Measurement.** R. E. Reason. *Institution of Mechanical Engineers Proceedings,* v. 153, '45, War Emergency Issue no. 10, p. 335-337.

Need of industry is for simple workshop instruments giving sensible measures of surface quality. Their provision is impeded mainly by lack of sound experimental data on what really needs to be measured, and on how accurately measurements should be made. A great deal of work will be required before general principles can be firmly established. (Paper for Symposium on Surface Finish.)

11-51. Measurement of Surface Waviness. C. Timms. *Institution of Mechanical Engineers Proceedings,* v. 153, '45, War Emergency Issue no. 10, p. 337-339.

A portable instrument of simple construction designed at the National Physical Laboratory for the measurement of the grosser surface irregularities. (Paper for Symposium on Surface Finish.)

11-52. Rational Specification of Surface Finish. W. A. Tuplin. *Institution of Mechanical Engineers Proceedings,* v. 153, '45, War Emergency Issue no. 10, p. 340-341.

Relation between pen record and bearing area; existing methods of specification of roughness. (Paper for Symposium on Surface Finish.)

11-53. Electronic Relays. Karl Keller. *Machine Design,* v. 18, Aug. '46, p. 119-122.

Provide control for machine elements from electrical impulses or mechanical pressures too minute for reliable operation by conventional methods. Typical application of the electronic contact-amplifier in a machine designed to automatically sort metal screw-machine parts is shown.

11-54. Scientific Instruments in Britain. Charles Darwin. *Engineer,* v. 182, July 26, '46, p. 78-79.

History of the cyclotron, X-ray, thermionics, slip gage, and others; responsibilities of the Department of Scientific and Industrial Research to instruments.

11-55. Measurement of Surface Roughness. C. Timms. *Metal Treatment,* v. 13, Summer '46, p. 111-118.

Instruments described with details of the range of roughness which each type can accommodate. Difficulties that have to be overcome in order to establish a rational specification for surface roughness and the progress at present made in the solution of these problems. Need for correlation between the physical and geometrical aspects of a surface in order to determine the surface qualities which are of importance. Unit adopted for the measurement of surface roughness in British practice is the micro-inch, where 1 micro-inch = 0.000001 in. or 0.0254 μ.

11-56. Effect of Elastic Modulus on Measurement of Thread Wires. D. E. Williamson. *Production Engineering & Management,* v. 18, Aug. '46, p. 61-64.

Analyzes various factors relating to use of Carboloy wires in the measurement of threads by the three-wire method.

11-57. A Glossmeter for Smoothness Comparisons of Machine-Finished Surfaces. Richard S. Hunter. *Journal of Research of the National Bureau of Standards,* v. 36, April '46, p. 385-391.

A photoelectric glossmeter was developed for possible

use as a production-inspection device for evaluating the roughness of fairly coarse machine-finished surfaces. Instrument has proved to be a simple and useful device for making rapid comparisons of the roughness of surfaces machined with about the same feeds.

11-58. **Electron Diffraction in Practice.** Wayne T. Sproull. *Industrial Radiography,* v. 5, Summer '46, p. 40-44.

Early history of electron diffraction; differences between electron diffraction and X-ray; relation between accelerating voltage and wave length; cameras; preparation of specimens; interpretation of patterns; applications of electron diffraction.

11-59. **Standing Wave Technique of Thickness Measurements.** John B. Butler and James B. Vernon. *Journal of the Acoustical Society of America,* v. 18, July '46, p. 212-215.

Blind thickness measurements in complex metal assemblies were made using the supersonic reflectoscope. Theory and result of measurements on a series of test blocks 0.0109 to 0.151 in. thick are presented. All measurements using the standing wave technique were accurate within 2%.

11-60. **The Construction and Use of a "Fly's Eye" for Assisting X-Ray Structure Analysis.** Alexander R. Stokes. *Proceedings of the Physical Society,* v. 58, May 1, '46, p. 306-313.

The "fly's eye" is the name given to a multiple camera for producing two-dimensional diffraction gratings consisting of repeated patterns representing projections of crystal structures. Describes construction of fly's eye using lenses embossed on Perspex; also necessary adjustments, method of photographing a structure, and apparatus for viewing the spectra produced by the two-dimensional gratings so obtained.

11-61. **Capacitive Micrometer.** R. W. Dayton and G. M. Foley. *Electronics,* v. 19, Sept. '46, p. 106-111.

Variations in oscillator frequency caused by minute movements of the capacitive circuit element are converted to output voltage changes in this practical electronic gage. The same principle has been successfully used for dilatometer, manometer, roughness gage and hardness testing apparatus.

11-62. **Sorting Alloys.** N. F. Agnew. *Electronics,* v. 19, Sept. '46, p. 124-125.

Portable instrument for machine shops sorts mixed bar stock, transformer laminations, billets or castings according to chemical composition by rubbing a known metal against the unknown for an interval determined by an electronic timer. The resulting triboelectric voltage is measured with a mirror galvanometer, using a bias rectifier for balancing.

11-63. **The Surface Condition and Reflectivity of Metals.** J. H. Nelson. *Journal of the Electrodepositors' Technical Society,* v. 21, '46, p. 113-120 (Reprint).

Theories of surface reflectivity are outlined. Superfinishing technique and method for comparison of finish

smoothness are described. Application of reflectivity as a tool in razor blade inspection is explained.

11-64. **Correction of X-Ray Powder Diffraction Films for Nonuniform Shrinkage.** Howard H. Claassen and Karl E. Beu. *Review of Scientific Instruments,* v. 17, Aug. '46, p. 307.

Common procedure in determining diffraction angles from Debye-Scherrer patterns is to measure distances on the photographic film and to correct for film shrinkage by applying a constant factor to all distances on the film. Usual methods for obtaining the factor are shown experimentally to be inaccurate. Improved correction method is described.

11-65. **An Easily Constructed All-Metal Vacuum Gage.** Robert T. Webber and C. T. Lane. *Review of Scientific Instruments,* v. 17, Aug. '46, p. 308.

Home-made apparatus which indicates pressure 1 to 10^{-3} mm. of mercury.

11-66. **Replica Method for Roughness Measurement.** H. Smoluchowski. *Review of Scientific Instruments,* v. 17, Aug. '46, p. 309.

Simple method which shows type of roughness, and can be used in hard-to-get-at places. Cellulose acetate dissolved in acetone is applied. Before it dries, cellulose acetate tape is pressed on. When it is pulled off, the bottom is covered with an accurate replica of the surface. In a variation of technique, dye is added to the solution, so that the replica may be exposed to a light-beam for quantitative roughness determination with a photo-cell.

11-67. **Will Industrial Electronic Control Use Microwaves?** W. C. White. *General Electric Review,* v. 49, Sept. '46, p. 8-11.

The most obvious industrial-control applications for these frequencies will utilize the interception or reflection of beams of these radiations for the purpose of counting, sorting, or inspection. Simple oscillator and intensity meter designed and built for demonstration purposes, and the demonstration of some microwave characteristics.

11-68. **The Evaluation of the Roughness of Lithographic Printing Plates.** G. A. H. Elton and C. McDougall. *Journal of the Society of Chemical Industry, Transactions and Communications,* v. 65, July '46, p. 212-216.

Methods developed for measurement of surface area, the surface void volume, and depth of grain of lithographic printing plates.

11-69. **Some Uses of the Magnetic Potentiometer for the Determination of Magnetization Curves Upon Open-Circuited Specimens.** T. A. Margerison and W. Sucksmith. *Journal of Scientific Instruments,* v. 23, Aug. '46, p. 182-184.

Use for determination of B-H curves on a wide variety of shapes of specimens. Method is simple and no corrections are necessary, while the accuracy obtained justifies far more extensive use of the potentiometer in magnetic determinations.

11-70. **Interference Microscope for Testing Surfaces.** *Industrial Diamond Review,* v. 6, Sept. '46, p. 276-279.

Instrument used for direct measurement of profile heights on smooth surfaces for maximum roughnesses of 0.05 to 2 microns.

11-71. Design and Operation of an Improved Counting Rate Meter. A. Kip, A. Bousquet, R. Evans, and W. Tuttle. *Review of Scientific Instruments,* v. 17, Sept. '46, p. 323-333.

Counting rate meter is an amplifier for use with Geiger-Muller counters, or any other random or periodic counting instruments. Important modifications were made several years ago, and tested over the past four years by the continuous use of some twenty instruments of the type described for physical, biological, and metallurgical research using radioactive isotopes.

11-72. Rotating Sample Holder for X-Ray Diffraction Studies. E. F. Champaygne. *Review of Scientific Instruments,* v. 17, Sept. '46, p. 345.

Details of construction.

11-73. A New Approach in Evaluating Surface Roughness of Gear Teeth. Louis D. Martin. *Product Engineering,* v. 17, Sept. '46, p. 110-114.

Proposed standard for comparing the surface roughness of teeth on fine-pitch gears and its extension to a similar standard for coarse-pitch gears. Tooth surfaces resulting from three primary methods of cutting gear teeth and from four secondary methods of improving surface finish are described.

11-74. Further Interferometric Studies With Mica. New Multiple-Beam Fringes and Their Application. S. Tolansky. *Proceedings of the Royal Society,* v. 186, July 9, '46, p. 261-271.

Description of three multiple-beam interference methods, used in this particular instance for the study of structural and surface topographical features of thin slips of mica. Deals with experimental techniques employed. Procedures described have wide potential applications and can be employed with any type of approximately plane surface, and to any solid or liquid transparent medium which does not attack silver.

11-75. Machine Tools and Production Equipment. *Machinery (London),* v. 69, Sept. 12, '46, p. 340-344.

Two interferometers of simple design, one for comparison purposes and the other for absolute measurement. Wear of the working faces of master and reference gages is completely eliminated since no actual contact is made with the faces to be compared or measured.

11-76. A High-Precision One-Inch Electrical Extensometer. H. M. Mahan and Wm. B. Warren. *Instruments,* v. 19, Sept. '46, p. 502-505.

A gage applicable to long-term studies, which retains the simplicity and sensitivity of the bonded-wire strain gage. The instrument is designed to measure with extreme precision the distance between numbers of pairs of gage points on a structure, at any time during a test period which would extend over months.

11-77. Metal Test Specimens Mounted in Urea. *Modern Plastics,* v. 24, Oct. '46, p. 121.

Brief description of how specimens for microscopic examination may be embedded in molded urea-formaldehyde cylinders.

11-78. The Electron Microscope and Its Application to the Study of Metals. Robert G. Picard. *Metallurgia,* v. 34, Aug. '46, p. 181-185.

Principle of the electron microscope; applications to colloidal particles, metallic smokes, evaporated metals, and structures of films only a few atoms thick; replica methods and metallographic applications.

11-79. Problems Concerning the Microchemical Balance. Part III. Construction. Cecil L. Wilson. *Metallurgia,* v. 34, Aug. '46, p. 219-222.

Considers briefly the different instruments which have been applied to the weighing of small amounts of material.

11-80. X-Ray Microradiography of Distorted Crystals. R. Smoluchowski, C. M. Lucht, and M. Mann. *Physical Review,* v. 70, Sept. 1 and 15, '46, p. 318-322.

The phenomenon of selective X-ray transmission within single grains of a metal foil is interpreted as a diffraction effect related to the distorted crystal lattice. This provides a new method for the study of the distribution of distortions in single crystals and throws light upon the magnitude of these distortions and their gradients.

11-81. Stress Analysis. *Automobile Engineer,* v. 36, Sept. '46, p. 401-406.

Equipment designed by Savage and Parsons, Ltd., for use in conjunction with resistance wire strain gages. Short account is given of some of the many uses to which resistance wire gages have been put in the U. S. A.

11-82. Mounting Fine Wire for Cross-Sectional Examination. R. L. Duffner. *Metal Progress,* v. 50, Oct. '46, p. 658-659.

Describes simple but effective method.

11-83. Edge Rounding Avoided With Cast Iron Grit. Anton L. Schaeffler. *Metal Progress,* v. 50, Oct. '46, p. 659.

Simple technique to prevent the plastic resin from wearing away faster than the imbedded alloy during the polishing of mounted specimens.

11-84. Electrolytic Polishing. Part I. *Metal Industry,* v. 69, Sept. 27, '46, p. 263.

Modern technique for metallographic specimens. Condensation of paper by P. A. Jacquet, *Bull. Soc. Francaise de Metallurgie,* v. 1, 1945, p. 1.

11-85. Process Control at Westinghouse East Pittsburgh Works. *Instrumentation,* v. 2, Sept-Oct. '46, p. 3-6.

Instrumentation used for master gages maintained at uniform temperature; circuit breaker testing requires air conditioning; control of armature ovens; toolsteel heat treating department; forging preheating and annealing; stress relieving furnaces; resin-treating ovens; plastic molding presses; wire enameling ovens; copper oxide rectifier production; and galvanizing kettles.

11-86. Measuring High Vacuums With the Thermal and Ionization Gage. J. Gordon Seiter. *Instrumentation,* v. 2, Sept-Oct. '46, p. 14-16.

Explains how vacuums down to 1 micron are measured, controlled, and recorded.

11-87. Demineralized Water in the Wire Mill. F. R. Morral. *Wire and Wire Products,* v. 21, Oct. '46, p. 759-761, 764.

Effects of water impurities on wire electroplating; details of ion-exchange demineralization by which these difficulties may be avoided. 12 ref.

11-88. Mobile Electronometer Records Stresses. Joseph Geschelin. *Automotive and Aviation Industries,* v. 95, Oct. 15, '46, p. 28-31, 67-68.

Describes mobile test trailer towed by the vehicle being tested in which amplification of the feeble current flow in the strain gages is accomplished through the use of two Brush electronic amplifiers. Uses Brush recording chart type of oscillograph which provides a permanent chart record of the behavior of each of the 48 strain gages.

11-89. Austenitic Grain Size. W. I. Pumphrey. *Iron and Steel,* v. 19, Oct. '46, p. 581-583.

Review of a number of etching methods available for the determination of the austenite grain size established at the quenching temperature in quenched steels, with particular reference to the application of these methods to a high-carbon chromium-molybdenum steel.

11-90. Electrolytic Polishing—II. *Metal Industry,* v. 69, Oct. 11, '46, p. 304.

Methods of revealing slip lines by a combined metallographic and X-ray examination using electrolytic polishing. 3 ref.

11-91. The Technique of Precise Electron-Diffraction Measurements With Polycrystalline Specimens. T. B. Rymer and C. C. Butler. *Philosophical Magazine,* v. 36, Dec. '45, p. 821-835.

In an earlier paper it was shown that it is possible to measure the radii of the Debye-Scherrer rings produced by the diffraction of electrons by polycrystalline specimens with an accuracy of about one part in 10,000. Measurements of this precision reveal a number of unexpected features, which are partly instrumental in origin and in part related to the crystal structure of the specimen. The following instrumental factors encountered in high-precision measurements are considered: alternating magnetic fields; high-tension voltage fluctuations; focusing technique and width of central electron beam; electrostatic effects; magnetic effects.

11-92. Surface Finish Measurement Instrumentation. James A. Broadston. *Tool & Die Journal,* v. 12, Oct. '46, p. 81-86, 106, 170.

Various commercial instruments used.

11-93. Electrical Observations of the Austenite-Martensite Transformation in Steel. Andrew W. McReynolds. *Journal of Applied Physics,* v. 17, Oct. '46, p. 823-833.

Method is described for observing the austenite-

martensite transformation in steel by measuring electrical resistance. Small wire samples are heated and cooled either in vacuum or in air while temperature and resistance are automatically recorded. From these data a complete record of transformation during cooling can be computed. Such transformation data have been obtained on three steels of widely different compositions, representing the types of steel in which transformation is most difficult to observe.

11-94. **Standard Classification of Machined Surface Finish.** P. E. Dyachenko. *Engineers' Digest,* v. 3, Oct. '46, p. 527-528.

New U. S. S. R. Standard Classification of microsmoothness of machined surfaces. (From *Vestnik Inshenerov i Tekhnikov,* Russia, no. 2, 1946, p. 73-78.)

11-95. **B-H Meter for Samples of Small Cross-Sectional Area.** Eugene C. Crittenden, Jr., Charles S. Smith, Jr., and Leonard O. Olsen. *Review of Scientific Instruments,* v. 17, Oct. '46, p. 372-374.

An instrument for measurement of the magnetic properties of samples of small cross-sectional area is described. It can be used with samples having cross-sectional areas as small as 10^{-5} sq. cm.

11-96. **Microfissures.** *Metal Industry,* v. 69, Oct. 25, '46, p. 347.

Microscopic investigation of crystal imperfections.

11-97. **Magnetism and the Magnetic Thickness Gage.** B. G. Bowman. *Monthly Review,* v. 33, Oct. '46, p. 1044-1045, 1092.

Procedure and results of calibration of magnetic gage employed in determination of nickel thickness of nickel plated panels of S.A.E. 1085 steel for outdoor exposure test.

11-98. **A Selection of Methods for Polishing Metallographic Specimens.** Freeman G. Anderson and Roy E. McGraw. *Wire and Wire Products,* v. 21, Nov. '46, p. 879-883, 916.

After filing or grinding the surface to be inspected, only three steps are necessary. First step is grinding on the lead lap; second step is to semi-polish on the paraffin wheel; third step is final polishing on the synthetic cloth.

11-99. **Room Temperature Casting Resin for Metallographic Mounts.** George L. Kehl and James S. Church. *Metal Progress,* v. 50, Nov. '46, p. 1089-1090.

A transparent plastic has been formulated which can be cast at ordinary temperature and is particularly applicable to mounting soft metals and those that might suffer structural changes at high temperatures.

11-100. **Use of Coated Lenses for Metallography.** Edward Walden. *Metal Progress,* v. 50, Nov. '46, p. 1097-1099.

Comparison of photomicrographs showing the advantages of fluoride-coated objective lenses over uncoated objective lenses using several different types of metallographic samples.

11-101. **Profile and Surface Analysis. Part I.** *Aircraft Production,* v. 8, Nov. '46, p. 509-512.

Development of technique for combined use of mechanical and optical magnification in high-precision measurement.

11-102. **Nature Printing Aluminum Alloy Forgings.** *Metallurgia,* v. 34, Oct. '46, p. 335.

An improved etchant formula to show flow lines.

11-103. **Testing of Furnace Atmosphere.** E. E. Howe. *Better Enameling,* v. 17, Nov. '46, p. 6-7, 44.

A few of the different gases which are encountered in the firing chamber of an enameling furnace. Except in rare instances two apparatuses, the Orsat and the Dewmeter, should supply sufficient information to insure trouble-free porcelain enamelware as to the quality of the atmosphere in the furnace chamber.

11-104. **Reproducing Drawings on Metal.** S. H. Barmasel. *Iron Age,* v. 158, Nov. 21, '46, p. 62-64.

Quick and simple method of reproducing engineering drawings, diagrams and instruction plates on nonporous surfaces. Process, which does not employ a silver emulsion, has the added advantage of eliminating darkroom techniques. Basic procedure; several recent developments; illustrations of its application.

11-105. **The Use of Punched Cards in Molecular Structure Determinations. I. Crystal Structure Calculations. II. Electron Diffraction Calculations.** P. A. Shaffer, Jr., Verner Schomaker, and Linus Pauling. *Journal of Chemical Physics,* v. 14, Nov. '46, p. 648-664.

Application of punched cards and electric accounting machines to crystal structure calculations. The machines may be used to evaluate Fourier series with greater accuracy, greater speed, and greater density of calculated points than is possible by the methods used heretofore. A method for punched card calculation of structure factors is also set forth, and use of the machines for reduction of observational equations to normal equations in least squares is discussed. In Part II, similar techniques are applied to determination of the structure of gas molecules from electron diffraction photographs.

11-106. **An Automatic Recording Balance.** Earle Thall. *Canadian Mining and Metallurgical Bulletin,* no. 415, Nov. '46, p. 663-670.

Balance suitable for continuous recording of small changes in weight over long periods of time.

11-107. **A New Electrochemical Jet Method of the Determination of Thickness of the Electrolytically Deposited Metal Layer (Cr, Ni, Sn, Cu, and Cd).** A. Ogarer. *Journal of Applied Chemistry* (U.S.S.R.), v. 19, no. 3, 1946, p. 311-315.

Newly developed method of electrochemical determination of thickness of electrolytically deposited metal layers.

11-108. **Electron Microscopy.** James Hillier. *American Ceramic Society Bulletin,* v. 25, Nov. 15, '46, p. 438-448.

Significance of the instrument as a research tool rather than technical details of its operation. 110 ref.

11-109. **Een Magnetische Laagdiktemeter. (A Magnetic Thickness-Measuring Apparatus.)** A. Schuringa. *Metalen,* v. 1, Sept. 15, '46, p. 10-11.

A newly developed apparatus for measuring the thickness of dielectric coatings on steel and iron (for example paint, varnish, enamel, etc.). A very rapid thickness determination may be performed even at almost inaccessible points.

11-110. **The Electron Microscope.** Gaston Dupouy. *Metal Treatment,* v. 13, Autumn '46, p. 153-168, 205.

Theory, construction and operation of the electron microscope; techniques devised for the preparation of the objects to be examined; some of the results so far obtained by its application to the study of metals.

11-111. **Phase-Contrast Microscopy for Mineral.** *Nature,* v. 158, Nov. 2, '46, p. 621.

Phase-contrast microscopy gives good results for mineralogical studies.

11-112. **Measurement of Thickness of Thin Films.** *Nature,* v. 158, Nov. 2, '46, p. 621.

How interference fringes formed by multiple reflection between highly reflecting surfaces can be used for determination of thickness of thin layers of gold, silica, collodion and "Formvar", which are widely used for supporting and other purposes in electron microscopy.

11-113. **Composition and Diffraction Effects in X-Ray Microradiographs.** R. Smoluchowski, C. M. Lucht, and J. M. Hurd. *Journal of Applied Physics,* v. 17, Nov. '46, p. 864-870.

Theory, experimental technique; advantages of the new technique over conventional photomicrographic methods for metallurgical applications.

11-114. **Electronic Voltage Compensators and Current Regulators.** L. A. Beck. *Electrical Manufacturing,* v. 38, Dec. '46, p. 115-118, 212, 214.

Types of controls which have been developed to provide automatic maintenance of constant root mean square current to industrial loads. Typical loads are resistance welding machines, resistance-type furnaces, and similar loads requiring constant root mean square current input.

11-115. **The Determination of X-Ray Diffraction Line Widths.** C. G. Shull. *Physical Review,* v. 70, Nov. 1 and 15, '46, p. 679-684.

Methods suggested for correcting X-ray diffraction line widths for geometrical effects. Experimental data are presented for two samples of finely divided NiO and MgO which show that neither the Warren nor the Jones correction method is valid for these particular specimens. A direct Fourier transform procedure is given which permits calculation of the corrected diffraction line width for all experimental cases. 11 ref.

11-116. **Cylindrometer for Measuring Large Diameters. Part I and II.** *American Machinist,* v. 90, Dec. 19, '46, p. 145, 147.

Describes and illustrates instrument meant for precise measurement of large pieces.

SECTION XII

INSPECTION AND STANDARDIZATION

12-1 **Quality Control.** H Howell. *Aircraft Production*, v 7 Nov '45 pp 338-342

Comparison of compressed limit gaging methods with measurement charts in dimensional quality control practice

12-2 **Supersonic Inspection.** *Steel*, v 117, Dec. 24, '45, pp 94, 96

Non-destructive inspection method for continuous production processes is capable of detecting flaws 0.001 in. thick within interior of metal parts

12-3 **The Growth of Industrial Radiology.** L. Mullins *Electronic Engineering*, v. 17, Nov. '45, pp. 760-763

Its growth and that of more recently established arsenal of X-ray crystallography reviewed with particular reference to those aspects of interest to electronic engineers 31 ref.

12-4 **Quality Control Testing of Semi-Finished Bars.** E W Mananey and D. W Lloyd *Iron & Steel Engineer*, v. 22 Nov. '45, pp. 48-50, 62.

Thorough application of statistical methods in an investigation of steel quality a control program was set up through which bar surface conditioning was greatly reduced. Defective product reduced 4% under previous normals

12-5 **Quality Control and Spot Welding.** N G Dod. *Aircraft Production*, v 7 Dec '45 pp 363-364

Application and value of statistical methods

12-6 **Recent Developments in Profile Control.** *Tool & Die Journal* v 11 Dec '45 pp 90-91

Projection screen chart of sufficient accuracy to employ for either tool checking or production inspection in interchangeable manufacture. Lines are produced that are readable against workpiece variations as fine as 0.0001 in.

12-7 **SIP Profile Projector, AP-9.** *Tool & Die Journal*, v 11, Dec. '45, pp. 92-93.

Permits outline projection of a variety of watch parts ranging from plates to the tiniest pinions of lapped screw

gages, worms, chasers, thread milling cutters, form tools, profile gages, master templates and blanking dies. Image can be instantly gaged in reference to a master drawing, accurately measured with glass scales, or photographed in the simplest manner.

12-8. **Statistical Methods in Quality Control, Part VII.** *Electrical Engineering,* v. 64, Dec. '45, pp. 448-450.
Control charts for analysis of variables. 3 ref.

12-9. **Fluoroscopy.** B. Cassen and D. S. Clark. *Metal Industry,* v. 67, Dec. 7, '45, pp. 375-377.
Comparison with radiography for flaw detection.

12-10. **Magnetic Analysis Inspection of Metals.** H. L. Edsall. *Materials & Methods,* v. 22, Dec. '45, pp. 1731-1735.
Electronic method detects internal defects and specification variations in steel bars, tubes.

12-11. **Duplicate Radiographs.** *Steel,* v. 117, Dec. 31, '45, p. 68.
With fast light-reversal process radiographs are sharp and accurate.

12-12. **Automaton Bubble-Tests Light-Metal Castings.** Roy Cummings. *American Machinist,* v. 90, Jan. 3, '46, pp. 116-117.
Porosity and like flaws found 16 times faster with a semi-automatic fixture incorporating adjustments for test pressure.

12-13. **Crack Detection.** *Iron & Steel,* v. 18, Dec. '45, p. 634.
Description of Metrolux fluorescent equipment.

12-14. **Specifications for Aluminum and Its Alloys.** *Metallurgia,* v. 33, Dec. '45, pp. 87-89.
Comprises an up-to-date, rationalized schedule.

12-15. **Non-Destructive Material Testing by the Hypersonic Analyzer.** *Machinery,* v. 52, Jan. '46, p. 184.
Method consists of a sound generator which sends a beam through the specimen to be tested. Specimen, depending on its properties, modifies the beam, and the resulting energy pattern is picked up on the side opposite the generator by means of a microphone. It is possible to so select radiation frequencies and electro-acoustic designs that the resultant beams through the material are highly modified by a given type of flaw in any given material.

12-16. **Applied Finishes—Standardization and Basic Principles of Procedure.** S. B. Ashkinazy. *Product Engineering,* v. 17, Jan. '46, pp. 24-28.
Principles and practices underlying the selection and establishment of standards for applied finishes to satisfy specific engineering and manufacturing requirements. Two other phases of standardization discussed are: Specifications for procurement, application, and inspection; and publicizing the standards to encourage their use.

12-17. **An Investigation of the Fluoroscopy of Light Alloy Castings.** B. Cassen and D. S. Clark. *Automotive & Aviation Industries,* v. 94, Jan. 1, '46, pp. 26-30, 78, 82, 85.
Investigation to determine more precisely the limitations of fluoroscopy, possibilities of improving fluoroscopy, the possibilities of substituting fluoroscopic examination for

radiographic methods in certain types of inspection, and the possibilities of extending the scope of fluoroscopic inspection methods to parts which cannot be economically radiographed. Results of examining approximately 10,000 castings with over 14,000 defects confirm that fluoroscope does not show very large numbers of very small defects that can be seen on the radiographs. Fluoroscope using rotational scanning shows a surprisingly large number of medium and larger defects that are not detected radiographically.

12-18. **A New Etching Reagent for the Detection of Oxygen Segregations in Steel.** Leslie Fine. *Metal Progress,* v. 49, Jan. '46, pp. 108-112.

Experiments, using alkaline chromate etch, detect dissolved iron oxides or oxygen. Procedures outlined.

12-19. **Other Non-Destructive Methods of Testing.** John W. Juppenlatz. *American Foundryman,* v. 9, Jan. '46, p. 38-41.

Agreement upon standards for interpretation of defects revealed by non-destructive testing methods is the controlling factor in the value of these methods as a test means. Workable standards, based upon the essential service of the material tested, should provide for ready definition into acceptable and non-acceptable classification. 7 ref.

12-20. **Magnetic Method for Testing Steel Quality.** H. Sjövall. *Engineers' Digest (American Edition),* v. 2, Dec. '45, p. 596-598.

The magnetic examination of machined steel component parts can be employed to advantage for the determination of their properties after heat treatment; it may also be found useful in sorting pieces of identical shape and material, but heat treated in different ways. It is possible to ascertain by the magnetic method whether or not the magnetic properties of a piece deviate from a chosen normal. (Abstract from *Jernkontorets Annaler,* v. 128, 1944, p. 610-614.)

12-21. **Developments in Standardization During 1945.** Frank W. Cramer. *Iron and Steel Engineer,* v. 23, Jan. '46, p. 118-120.

American Standards Association; National Electrical Manufacturers Association; American Institute of Electrical Engineers; American Society for Testing Materials; Association of Iron and Steel Engineers.

12-22. **Compressor Castings.** A. F. Hammond. *Foundry Trade Journal,* v. 77, Dec. 20, '45, p. 351-352.

Inspection and testing in the manufacture of castings forming part of air compressors, exhausters, etc., in foundry which is of the jobbing type.

12-23. **"Hypersonic" Analyzer Provides Non-Destructive Materials Test.** *Tool and Die Journal,* v. 11, Jan. '46, p. 88-90.

"Hypersonic" method detects flaws associated with two physical properties of the material—an apparent change in density and/or an apparent change in the modulus of elasticity. Completely satisfactory tests have already been made on aluminum, phosphor bronze, beryllium-copper, brass, other metals and alloys.

12-24. **Quality Control With the Recording Geiger-Counter X-Ray Spectrometer.** J. S. Buhler. *Industrial Gas,* v. 24, Jan. '46, p. 17-19, 33-34.

Time element has been radically reduced so that valuable information regarding structures and physical states of materials can be gained in a matter of minutes. Describes fundamentals of diffraction.

12-25. **Notes on Inspection.** R. J. Hart. *Foundry Trade Journal,* v. 78, Jan. 3, '46, p. 3-8, 21.

Methods employed in routine inspection, both of pattern equipment and castings—mainly steel castings, although the same principles can apply to other metals. Inspection of patterns and samples; bulk inspection; physical testing, and delegated inspection.

12-26. **Testing and Inspection.** Harold A. Knight. *Materials and Methods,* v. 23, Jan. '46, p. 145-150.

Electric and electronic inspection; spectrography; magnetic inspection; hardness and hardenability testing; strain gages; surface measurement; radiography and metallography.

12-27. **Supersonic Testing in a Steel Plant.** J. V. Russell and H. E. Pellett. *Iron Age,* v. 157, Jan. 31, '46, p. 38-43.

Use of the Sperry supersonic reflectoscope in testing for internal soundness in billets and blooms up to 20 in. square. Results in this, the first industrial application of this instrument, suggest that a new and valuable testing technique is now available to the steel industry, particularly for the locating of intermittent internal defects.

12-28. **Magnetic Particle Testing Prevents Railroad Failures.** Lawrence B. Sagle. *American Machinist,* v. 90, Jan. 31, '46, p. 106-107.

Flaws in forgings and castings are detected in advance through the use of a periodic inspection plan that avoids interruptions in service and delays in trains.

12-29. **Methods of Quality Control.** Merrill S. Hugo. *Western Machinery and Steel World,* v. 37, Jan. '46, p. 19, 37-38.

Specification of quality; methods of control; control of quality by process; control of quality by machine tools; control of quality by cutters; control of quality by jigs and fixtures; control of quality by limit gages; analysis of inspection data.

12-30. **Statistical Methods in Quality Control, VIII—Control Charts for Action on Variables.** *Electrical Engineering,* v. 65, Jan. '46, p. 23-24.

Use of control charts for action when inspection is by the methods of variables and the factors for control are averages and ranges. Method is illustrated by a typical application—the cutting of small sleeves from a tubing material where weight is one of the critical characteristics to be controlled. 4 ref.

12-31. **Acceptance Standards for Castings.** Leslie W. Ball. *Aircraft Production,* v. 8, Jan. '46, p. 3-6.

Use of radiography and X-ray micrography in assessment of quality.

12-32. **Magneto-Inductive Testing.** H. Mader. *Metal Industry,* v. 68, Jan. 18, '46, p. 46-48.

German instrument known as the "Durokawimeter" designed for the acceptance testing of light alloys. Claimed that it will detect cases of faulty heat treatment, cracks in castings and variations in chemical composition.

12-33. **Inspection of Rough Castings.** R. S. Durrell. *Foundry Trade Journal,* v. 78, Jan. 24, '46, p. 91-92.

Check on pattern equipment; metallurgical and physical properties of the metal.

12-34. **Controlling Gray Iron Quality.** John E. Linabury. *Foundry,* v. 74, Feb. '46, p. 90, 250-254.

Various factors contributing to production of high quality castings.

12-35. **Two Million Volt X-Ray Inspection Equipment.** David Goodman. *Metal Progress,* v. 49, Feb. '46, p. 327-332.

"Super-voltage" X-ray of two million volts was used for inspecting loaded shells and bombs at the Elwood Ordnance Plant. Can make non-destructive tests showing flaws at any depth or thickness in heavy parts; speed of such high-voltage X-ray permits the examination of each piece in a suspect sub-lot. Also allows reworking of defectives and then X-raying them again to determine whether flaw has been remedied. Installation of equipment described.

12-36. **Light Wave Method for Determining Straightness.** Joseph Dauber. *Production Engineering and Management,* v. 17, Feb. '46, p. 77-78.

Accurate indications of departure from straightness are obtained by using an optical flat and a monochromatic light for checking knife edge of alloy steel pivots for precision instruments.

12-37. **Inspection of Steel Castings.** C. F. Rohlkoetter. *American Foundryman,* v. 9, Feb. '46, p. 70-74.

Some of the new tools and their effect upon inspection procedure and upon quality of inspection.

12-38. **Supersonic Flaw Detectors Employ Piezoelectric Crystals.** *Electrical Manufacturing,* v. 37, Feb. '46, p. 142, 144, 146, 222, 224.

One instrument translates elapsed time to receive echo of high-frequency pulse signal into depth of flaw below surface; the other passes continuous supersonic mechanical waves through sheet specimen and picks them up on microphone.

12-39. **Inspection Methods Under Buick's New Program.** Charles N. Ofield. *Machinery,* v. 52, Feb. '46, p. 139-147.

With use of gaging fixtures described, 30 frames can be completely checked per hour, whereas by the previous method, in which frames were set up on a surface plate, it took two men 32 man-hours to check a single frame. Master gage employed to check the gaging fixtures periodically. Other inspection procedures discussed.

12-40. **Standardization Pays Dividends.** B. C. Boulton. *Machine Design,* v. 18, Feb. '46, p. 126-128.

Potentialities of standardization in practice illustrated by examples of high strength internal wrenching bolt,

ball-bearing pulley, hydraulic fittings, fuel-cell fittings, surface finish.

12-41. **Statistical Quality Control of Metal Stampings.** G. R. Armstrong. *Iron Age,* v. 157, Feb. 21, '46, p. 46-48.

Three principal phases of the statistical method as used by the inspection department in connection with stamping problems are: *(a)* frequency distribution diagrams, *(b)* correlation charts, *(c)* control charts. Simplicity of methods illustrated by few examples.

12-42. **High-Voltage Radiography.** David Goodman. *Iron Age,* v. 157, Feb. 21, '46, p. 58-61.

Use of one and two million-volt X-ray equipment, which permits examination of steel sections up to 12 in. thick with a 2-hr. exposure.

12-43. **Electronic Measurement, Analysis and Inspection.** H. L. H. *Machinery,* v. 68, Jan. 24, '46, p. 113-118.

Applications of electronic devices in the mechanical field.

12-44. **Practical Application of Statistical Methods in a Quality Control Program.** W. T. Rogers. *Blast Furnace and Steel Plant,* v. 34, Feb. '46, p. 233-235.

A comparison of two common methods of presenting data together with certain representative practical applications.

12-45. **Statistical Methods in Quality Control. Part IX. Acceptance Sampling.** *Electrical Engineering,* v. 65, Feb. '46, p. 81-83.

Acceptance sampling plans used in inspections performed by the method of attributes including single sampling, double sampling, and multiple sampling. A number of typical "operating characteristics" of sampling plans. 5 ref.

12-46. **Autoradiographic Detection of Aluminum.** William E. Stephens and Margaret N. Lewis. *Physical Review,* v. 69, Jan. 1 and 15, '46, p. 43.

Segregation of aluminum in silicon has been shown by autoradiography made possible by irradiating of specimen with neutrons.

12-47. **Magnetic Inspection of Welds.** Gilbert C. Close. *Steel Processing,* v. 32, Feb. '46, p. 122-125.

Certain principles of magnetic inspection, and how they may be utilized to detect defects in ordinary fusion welds in all ferrous materials.

12-48. **X-Ray as a Foundry Control Tool.** *Aluminum and Magnesium,* v. 2, Feb. '46, p. 18-21.

Production of X-rays; operational and equipment costs; small casting production; fluoroscopy; personnel.

12-49. **X-Ray Diffraction Applied to Shot-Peened Surfaces.** E. W. Milburn. *Metal Treatment,* v. 12, Winter, '46, p. 259-260.

Samples, their preparation and method of applying X-ray diffraction patterns. Results illustrated.

12-50. **Specifications and the Materials Engineer.** J. L. McCloud. *Materials and Methods,* v. 23, Feb. '46, p. 412-413.

Suggestions for their application. (Based on a paper presented at the S.A.E. Annual Meeting, Jan. 7-11.)

12-51. **Technique and the Future of Industrial Radiography.** M. B. Evans. *Industrial Radiography,* v. 4, Winter, '46, p. 19-22.

A generalized review of most of the war improvements in X-ray technique with an analysis of the effects of these improvements on postwar usage. Various new applications of X-ray and gamma rays discussed. 7 ref.

12-52. **Radiography With the Betatron.** G. D. Adams. *Industrial Radiography,* v. 4, Winter, '46, p. 23-25, 28-30.

Nature of 20-million volt X-radiation and its distinguishing characteristics. The betatron is a generator of this radiation. Physical characteristics of the betatron and its radiographic use. Exposure charts, techniques, personnel protection.

12-53. **Ultra High Speed Radiography.** Edward R. Thilo. *Industrial Radiography,* v. 4, Winter, '46, p. 40-43.

Cold cathode X-ray tube which will pass electron currents of 2,000 to 3,000 amp. in a microsecond permits the taking of ultra high speed radiographs through an inch of steel. Radiographs have been taken of bullets penetrating armor, jacket failure inside the gun, explosion of shell and burning of rocket powder. 3 ref.

12-54. **Stainless Steel Standards.** *Western Metals,* v. 4, Feb. '46, p. 42.

Covers austenitic chromium-nickel, hardenable chromium, and non-hardenable chromium.

12-55. **R^{2} for Better Inspection.** *Modern Industry,* v. 11, March 15, '46, p. 34-38.

Motion study, plant layout, statistical control, combined with new machinery, new labor-saving devices slash rejects, speed production, and safeguard customer relations. Tells how it can be done.

12-56. **Defects in Steel.** A. J. K. Honeyman and A. Fisher. *Iron and Steel,* v. 19, March '46, p. 103-109.

Surface examination; deep-etch test; sulphur print test; defects revealed by deep-etch and sulphur print tests; step tests and inclusion counts; crack detection tests.

12-57. **Radiography With Multimillion-Volt X-Rays.** H. R. Clauser. *Materials and Methods,* v. 23, March '46, p. 706-709.

Recent high energy X-ray developments make possible better examination of materials and metal parts of complicated form and of greater thickness. 11 ref.

12-58. **Inspects Heavy Steel Sections With 1000-Kv. X-Ray Unit.** *Steel,* v. 118, March 25, '46, p. 122-124.

Equipment installed by Bethlehem affords rapid inspection of castings. Numerous exposures on a variety of products are possible with ease of manipulation and safety. Work handled on 40-ton powered transfer car and 8-ton crane.

12-59. **Developments in Tests and Standards.** *Canadian Metals and Metallurgical Industries,* v. 9, March '46, p. 32-33, 49.

A.S.T.M. accomplishes important work at Pittsburgh meeting.

12-60. **Statistical Methods in Quality Control. Part X. Classification of Defects and Quality Rating.** *Electrical Engineering,* v. 65, March '46, p. 117-119.

Classification of defects according to seriousness; methods of rating quality based upon each classification.

12-61. **Comparator Gage More Efficient Than Ever.** H. J. Chamberland. *Western Machinery and Steel World,* v. 37, March '46, p. 124-126.

Because the spindle movement is electrically magnified, exact repeat readings are assured through elimination of moving parts. Variable spindle pressure is provided for measuring thick or thin sections, as well as hard and soft materials. The gage head swivels 360° in both horizontal and vertical planes; it can also be removed from the base and used on a surface plate, machine tool, multiple gaging fixture, and for many other applications heretofore excluded from this scientific method of inspection.

12-62. **Gage Blocks and Related Instruments.** H. J. Chamberland. *Machine Tool Blue Book,* v. 42, April '46, p. 139-140, 142, 144, 146, 148, 150, 152.

Advantages of use in shop production. "Working quality" and "laboratory quality" gage blocks.

12-63. **Procurement Procedure and Control at Eastman Kodak.** *Die Casting,* v. 4, April '46, p. 21-22.

Method of quality control for die castings, which has helped substantially to increase production, decrease rejects, and which marks an important advance in cooperation between die casters and the manufacturer.

12-64. **Exposure Chart for Radiography of Steel.** Herbert R. Isenburger. *Metal Progress,* v. 49, April '46, p. 760C-760D.

Charts are based on the following combination: *(a)* pulsating direct-current tension generating equipment; *(b)* line-focus X-ray tube; *(c)* industrial intensifying screens; *(d)* safety X-ray film, fast screen type; *(e)* 5-min. development at 65° F.; *(f)* film density 0 ? H. & D.

12-65. **Measurement of Cones in V-Blocks.** N. P. Skinner. *Machinery (London),* v. 68, March 7, '46, p. 310-312.

Possible arrangement of equipment for comparator method of inspecting such items as taper pins, machine tapers, etc.

12-66. **Simplified Quality Control Cuts Inspection Costs.** Erwin Tooley and W. F. Schleicher. *Production Engineering and Management,* v. 17, April '46, p. 74-77.

Offers following advantages: *(a)* Drastically reduces the number of inspectors on the final inspection line. *(b)* Increases the efficiency of floor inspectors. *(c)* Maintains a check on floor inspectors in the performance of their duties. *(d)* Reduces by 33% the time consumed in making final inspection checks.

12-67. **Quality Control for Decentralized Production.** John T. Smith. *Production Engineering and Management,* v. 17, April '46, p. 108-111.

Utilizing an unusual quality control system, Harry Ferguson, Inc., maintains precision manufacturing standards in farm implement output at 110 factories.

12-68. **Gear Inspection Time Cut by Use of Masters.** W. J. Adams. *American Machinist,* v. 90, April 11, '46, p. 104-107.

Essential properties of gears; determination of gear size; gear eccentricity or runout; determination of tooth error; tolerance factors for spur gears; composite gear checking system; practical example; master gears.

12-69. **Acceptance Standards.** *Automobile Engineer,* v. 36, March '46, p. 101-104.

Determination of casting quality by radiography and X-ray micrography.

12-70. **Fluoroscopy of Light-Alloy Castings.** B. Cassen and D. S. Clark. *Iron Age,* v. 157, April 18, '46, p. 48-50.

Significance of observed defect on usability of castings and use of higher X-ray voltages to obtain greater screen brightness. Examination of steel castings at voltages from 140 kv. to 200 kv. (Supplements previous report published in *Iron Age,* Nov. 1, 1945.)

12-71. **Three-Wire Thread Gaging Simplified.** John J. Meadows. *Iron Age,* v. 157, April 18, '46, p. 51-57.

Charts and tables eliminate time-consuming calculations commonly involved when gaging male threads over three wires. Thread forms covered include National fine and National coarse series, Whitworth standard, British Association, British standard fine, and French standard.

12-72. **Inspection Cross Checks by Improvisation.** A. N. Appleby. *Machinery (London),* v. 68, March 14, '46, p. 339-340.

Improvised system of cross check where a one-off or prototype production is required. Measuring bore of a die. Gages for testing radial disposition of dovetail keys and keyways. Feather-edge disk for checking width of an obtuse angular groove. Device for testing try square.

12-73. **Bursting Defects in Cast Aluminum Cylinder Heads.** S. A. J. Sage. *Metallurgia,* v. 33, March '46, p. 231-235.

Unit was composed of a cast aluminum alloy head, screwed and shrunk onto a forged and machined steel barrel; one of the problems concerned small bursting defects on the surface of the cast heads which were discovered on removal from the solution treatment in a salt bath. Investigation to determine cause and to effect a solution.

12-74. **Inspection on Jig-Boring and Jig-Grinding Machines.** J. R. Moore. *Machinery,* v. 52, April '46, p. 160-165.

Checking of work before removal from the jig-borer or jig-grinder provides a fast, accurate method of inspection.

12-75. **Gear Tooth Wear and Failure.** *Machinery,* v. 52, April '46, p. 166-169.

Standard terms used to explain different types of tooth wear and failure.

12-76. **Classification and Inspection of Castings for Airplanes.** M. A. Melcon. *Automotive and Aviation Industries,* v. 94, April 1, '46, p. 40-85.

Method of inspection results in elimination of all castings which have defects which are objectionable in any degree. Keeps critical areas of all castings up to a high degree of homogeneity and structural soundness. Keeps noncritical areas up to a reasonable standard of quality. Keeps a constant check on the foundry and makes certain that the quality on all castings is maintained.

12-77. **Gage Inspection and Maintenance.** *Machinery (London),* v. 68, March 28, '46, p. 393-399.

Metrology Division is responsible for inspection and maintenance of all gages and measuring apparatus used by A.I.D., and the technical control of a number of gage-testing rooms at various points in the country. Equipment and test methods described.

12-78. **Check Testing Aircraft Components and Gages.** *Machinery (London),* v. 68, April 4, '46, p. 425-428.

A few of the special applications in the main gage room and the gun and ammunition gage room at the test house. General view in the main gage room is given.

12-79. **Nondestructive Inspection of Castings.** Clyde L. Frear and Robert E. Lyons. *American Foundryman,* v. 9, April '46, p. 120-133.

Intelligent application of nondestructive test methods, old and new, by trained inspection personnel working with sound acceptance standards enables the foundry to determine exact locations of defective areas, change foundry techniques to eliminate them, and produce quality castings at lower cost.

12-80. **Microradiography—a Valuable New Metallographic Tool.** *Metal Industry,* v. 68, April 12, '46, p. 285.

Principle of the method and some of its uses. Distinguishes between cavities and inclusions, and reveals true shape of defects.

12-81. **"Flying Mike".** *Steel,* v. 118, April 22, '46, p. 87, 135.

Continuous gage for rolled strip has throat depth of 10 in. making it possible to measure to center of material 19 or 20 in. wide.

12-82. **Quality Control in a Screw-Machine Department.** A. L. Atherton. *Screw Machine Engineering,* v. 7, April '46, p. 64-69.

The place of inspection in manufacture; the contribution by statistical methods; patrol inspection procedure; general principles applied to screw-machine work; results.

12-83. **Radiographic and Fluoroscopic Interpretation of Casting Irregularities.** Thomas E. Piper. *Iron Age,* v. 157, May 2, '46, p. 46-49.

An effort to improve nondestructive inspection of quality castings for aircraft use, thus minimizing unnecessary rejections. Use of X-ray and fluoroscopic methods. Definition produced by the fluoroscope evaluated as compared with radiography; appearance to the radiographer of 14 types of defects is illustrated.

12-84. **The Detection of Cracks in Steel by Means of Supersonic Waves.** C. H. Desch, D. O. Sproule and W. J. Dawson *Iron and Steel Institute Advance Copy,* March '46, 23 p.

Section 1 reviews previous methods of detecting flaws in steel by means of sound waves, especially of high frequency. Section 2 describes apparatus employing piezoelectric quartz transmitters for producing intermittent pulses of supersonic waves and receiving them on similar quartz crystals after reflection, the reflected waves being electrically amplified and indicated on a cathode-ray oscilloscope. Conditions for obtaining sharp indications are discussed, as well as effects of the degree of finish of the metallic surfaces under examination. Section 3 gives results of applying the method to large masses, billets, plates, castings, and welds.

12-85. **Metallurgical Defects in Wrought Aluminum Alloys.** Lawrence J. Barker. *Light Metal Age,* v. 4, April '46, p. 12-15.

Some of the more important metallurgical defects occurring in wrought aluminum alloys; their means of identification and their importance.

12-86. **Technical Records in the Foundry.** R. D. Lawrie. *Foundry Trade Journal,* v. 78, April 11, '46, p. 387-390.

Application of modern controlled methods to production of a variety of gray-iron castings. By keeping careful records of every phase in the production of certain castings, it is possible to maintain a high standard of quality, keep an accurate record of casts, and a permanent record of all manufacturing data. Examples are included of technical records for certain castings manufactured for a variety of uses.

12-87. **Efficient Foundry Quality Control Department.** Glenwood J. Beckwith. *Aluminum and Magnesium,* v. 2, April '46, p. 10-13, 32.

Essential elements of a foundry's quality control department. Core and mold inspection; melting practice control; hot inspection; detail inspection; final inspection; pressure testing.

12-88. **High-Temperature Oxidation in Aluminum-Alloy Forgings.** Lawrence J. Barker. *Iron Age,* v. 157, May 9, '46, p. 61-64.

Mechanism of high-temperature oxidation in 14S-T aircraft forgings, its causes, prevention, appearance and effect. Method of classifying the severity of this defect, in terms of its effect upon physical properties to avoid unnecessary rejections.

12-89. **Magnetic Inspection Procedure.** E. D. Wilcox. *Machinery (London),* v. 68, April 18, '46, p. 489-495.

Principles of magnetic inspection and the procedure. Circular and longitudinal methods; residual and continuous methods; care of machines; demagnetization after testing; defects located by magnetic inspection.

12-90. **Use of Future Steels to Depend on Costs.** Maurice N. Landis. *Steel,* v. 118, May 13, '46, p. 97.

Advice on steel specifications of the future. New steels will be developed while old favorites will disappear. Induction hardening is causing major shift to carbon steels.

12-91. **Microradiography.** S. E. Maddigan. *Industrial Radiography,* v. 4, Spring '46, p. 22-25, 28-30.

Development of the microradiographic method is traced from the early absorption experiment by Heycock and Neville. Details of modern technique, considering the use of a single tungsten target with variable voltage as well as the use of several target elements with a variety of characteristic wave lengths. Absorption effects are explained by analogy with visible light. Numerous applications discussed.

12-92. **Radium Examination of Welds.** Joseph S. Harris. *Industrial Radiography,* v. 4, Spring '46, p. 37-40, 47.

Ability to detect flaws within the body of the material without destructive sectioning of the casting or weldment has resulted in improving the quality and production rate of many war and civilian products without any uneconomical increase in costs.

12-93. **Gage Checks Cylinder Blocks Automatically at 32 Points.** *Iron Age,* v. 157, May 23, '46, p. 49.

Performs the entire gaging job in less than 60 sec. Gaging instrument weighs several thousand pounds and is about 4 ft. wide, 8 ft. long and 7 ft. in height, and accurately measures to 0.0001 in.

12-94. **Braille Instruments Aid Blind Inspectors.** *Iron Age,* v. 157, May 23, '46, p. 56-57.

Vernier calipers and height gages, and micrometers reading to 0.0001 in., are now available with special Braille markings for use by blind inspectors. Developed in Britain by two prominent gage manufacturers as an aid to the rehabilitation of war wounded.

12-95. **Nondestructive Testing Methods.** Rupert Le Grand. *American Machinist,* v. 90, May 23, '46, p. 119-142.

Five types of radiographic inspection—X-ray, gamma-ray, fluoroscopy, photofluoroscopy and X-ray diffraction—principles of operation, uses, advantages and limitations. Magnetic particle inspection for surface and near-surface discontinuities—magnaflux, magnaglo, fluorescent penetrant inspection. Supersonic inspection for laminations and deep-seated flaws—Sperry supersonic reflectoscope, Brush hypersonic analyzer, Sperry supersonic Thruray. Thickness gages for irregularities in tubing—Penetron thickness gage, Probolog tube inspector. Film thickness gages for measuring from one side of coating—Magne-Gage, G. E. thickness gages, Filmeter. Spectrographic examination for material analysis—X-ray spectrometer. Magnetic analysis inspection—bar and tube checkers, machined parts analysis, the Cyclograph, magnetic analysis comparator, the Ferrograph.

12-96. **Improved Measurements for Industrial Processes.** Douglas M. Considine and Donald P. Eckman. *Steel,* v. 118, May 27, '46, p. 94-100.

The recording polarograph for determining the chemical constituents of either aqueous or nonaqueous solutions; ultraviolet and infrared spectrophotometers; measuring high vacuums; recording Pirani gage; recording McLeod gage; refinements in pH measurement.

12-97. **The Supersonic Flaw Detector and Its Applications in the Sheet Metal Industries.** A. C. Rankin. *Sheet Metal Industries,* v. 23, May '46, p. 893-898.

The apparatus and the principles involved; description of the instrument; frequencies used; general considerations of application; inspection of finished product; process control.

12-98. **Supersonic Waves—the Detection of Cracks in Steel.** C. H. Desch, D. O. Sproule and W. J. Dawson. *Iron and Steel,* v. 19, May 10, '46, p. 309-322.

The supersonic flaw detector and the application of supersonic testing to steelworks problems.

12-99. **Inspection of Welding.** C. L. Railton. *Welding,* v. 14, May '46, p. 232-236.

Courses described include all the main welding processes.

12-100. **Inspection and Testing of Materials—Some Recent Developments.** J. W. Donaldson. *Metal Treatment,* v. 8, Spring '46, p. 61-69.

Survey and review of the more recent work carried out on methods of testing, both destructive and nondestructive.

12-101. **Inspection Operations on Jig-Boring Machines.** J. R. Moore. *Machinery (London),* v. 68, May 16, '46, p. 617-622.

Feasibility, accuracy, and economy of checking work before removal from the jig-borer.

12-102. **Two-Million-Volt Industrial Radiography.** L. Cardenas. *Iron Age,* v. 157, June 13, '46, p. 52-55.

First two-million-volt X-ray unit to be installed in an industrial plant in the U. S. is described. Types of materials and structures particularly suitable for inspection by a machine of this high power are listed and such high voltage X-ray generators as the low-frequency resonance transformer, the Van de Graaff generator and the betatron are discussed.

12-103. **Metallic Materials Inspection.** J. E. Garside. *Metal Treatment,* v. 13, Spring, '46, p. 3-18.

Nondestructive testing of metals both ferrous and nonferrous. Determination of chemical composition by physical and chemical methods. Determination of physical condition in relation to hardness and other mechanical properties. Methods for ascertaining metal wall thickness and coating thickness, detection of surface defects and of unsound material, and for determining structure. 30 ref.

12-104. **Magnaflux Test of Diesel Locomotive Parts.** M. C. Haber. *Railway Mechanical Engineer,* v. 120, June '46, p. 304-307.

During the last few years the demand for more dependable methods of checking important locomotive parts has caused the railroads to give greater consideration to results obtained by magnaflux tests. In July 1939, the Union Pacific executed a service agreement and license with the Magnaflux Corp. permitting the use of magnaflux at any point on the railroad. As of January 1, 1946, the Union Pacific has these facilities available at 26 major and secondary shops, including six shops where diesel-electric locomotives are being maintained.

12-105. **X-Ray Checks Casting Quality.** *Foundry,* v. 74, June '46, p. 95, 262.

Installation of a 1000-kv. X-ray unit in the steel foundry at Bethlehem Steel Co. permits the inspection of heavy sections with a minimum of exposure time. The Bethlehem unit is designed for the routine inspection of heavy sections of steel up to 8 in. in thickness.

12-106. **Snap Switches Speed Gaging.** Arthur L. Riche. *American Machinist,* v. 90, July 4, '46, p. 112-115.

Typical gaging operations are presented to demonstrate how lamp-operating switches serve as accurate inspection tools.

12-107. **Inspection Methods in Automobile Production.** C. N. Ofield. *Machinery (London),* v. 68, May 30, '46, p. 681-688.

Shows various gaging units and explains their application at Buick inspection division.

12-108. **Internal and External Hot Tears.** H. F. Bishop and H. F. Taylor. *Foundry,* v. 74, July '46, p. 82-87, 218.

Since the internal hot tear and the external hot tear arise from different conditions and are remedied by unlike methods it is important that they be properly identified when observed on radiographs. The internal shrinkage tear and the external hot tear have individual characteristics which make their identification possible.

12-109. **Why Specifications?** John W. Bolton. *Foundry,* v. 74, July '46, p. 100-101, 210-213.

Great advances have been made in developing specifications for materials but further improvement is desirable.

12-110. **Supersonic Testing.** *Automobile Engineer,* v. 36, June '46, p. 265-272.

Detection of cracks in steel by means of short length sound waves. Brief description of the apparatus manufactured by Henry Hughes and Son, Ltd. Application of the technique to steelworks problems is discussed. Results are given of tests on large masses, billets and bars, slabs and plates, and castings.

12-111. **The Detection of Cracks in Steel by Means of Supersonic Waves.** C. H. Desch, D. O. Sproule, and W. J. Dawson. *Engineer,* v. 181, May 24, '46, p. 467-468.

Discussion of a paper presented at the meeting of the Iron and Steel Institute in March 1946.

12-112. **The Supersonic Method for the Detection of Internal Flaws.** E. G. Stanford and H. W. Taylor. *Metallurgia,* v. 34, June '46, p. 59-66.

Examination of the method as applied to aluminum alloy billets and semifinished components. Remarkably good results have been obtained on rectangular sections and cylindrical bar, but extruded sections of complicated shape are difficult to deal with. Apparatus may be assembled for routine testing under production conditions.

12-113. **Precision Measurement. Part I—Introduction to Precision Measuring Equipment.** Warren Baker. *Machine Tool Blue Book,* v. 42, July '46, p. 129-130, 132, 134, 136, 138, 140, 142, 144, 146, 148.

Instruments the tool inspector must use to be sure his production instruments are measuring as they should. Use of these "inspectors' instruments" in the measurement and calibration of production inspection equipment from the simplest to the most complex, even including checking of the inspection instruments themselves.

12-114. **Measuring the Effective Diameter of Screw Threads.** *Machinery (London),* v. 68, June 13, '46, p. 756-757.

Two methods devised by Thomas Firth and John Brown Ltd.

12-115. **A Practical Application of the Quality Control Chart.** F. L. Harrison. *Foundry Trade Journal,* v. 79, June 13, '46, p. 161, 168.

Constructing the charts; potential variables; interpretation of charts; revision of control limits.

12-116. **A New Approach to Statistical Quality Control.** Joseph Manuele. *Automotive and Aviation Industries,* v. 95, July 1, '46, p. 21, 77-78.

First step is to acquire some information on which parts, or items, are of a satisfactory quality level; which items are of such a low quality level as to result in rejections; and what is the relative amount of rejections of each product? An economical inspection program for accumulating this information is the use of a simple sampling plan for sampling all lots of items processed.

12-117. **Gear Quality Control.** George P. Maurer. *Production Engineering & Management,* v. 18, July '46, p. 55-61.

Important factors in the design and manufacture of involute tooth forms are explained.

12-118. **Electronic Comparator Gage.** W. H. Hayman. *Electronics,* v. 19, July '46, p. 134-136.

Standard-size piece of work is used to balance an indicating meter to center. Desired limits of deviation are then set up. Movement of the gage point in production inspection varies the inductive relationship between two coils to light lamps indicating parts that are either oversize or undersize.

12-119. **Precise Measurements and Inspection by Stereoscopic Radiography.** B. J. DeSimone. *Metal Progress,* v. 50, July '46, p. 71-74.

The stereographic method of radiography has been experimentally adapted to the measurement of wall thickness of hollow steel propeller blades and the determination of the exact location of minor defects in the materials of construction. The instrument used is the Orthoscope, which permits accurate and direct readings from two simple exposures. This method possesses certain advantages over the densitometric method.

12-120. **Some Results of Advances in Welding and Radiography on the Welding of Pressure Vessels.** O. R. Carpenter. *Welding Journal,* v. 25, June '46, p. 531-542.

Radiographic technique as it pertains to pressure vessels; a type of defect now most troublesome together with a speculation as to its cause; a recently developed method of

inspection which is hoped will qualify or perhaps eliminate this particular trouble in the welding of pressure vessels.

12-121. **Fluoroscopy—Application to the Examination of Metallic Objects.** B. Cassen and D. S. Clark. *Metal Industry,* v. 69, July 12, '46, p. 25-27.

Preliminary survey; variables; rotational effect; field tests; radiographic consistency. Concluded that there is no reason why flouroscopy should not be used as an inspection tool, provided its limitations are recognized.

12-122. **Gamma Ray Inspection.** Walter W. Offner. *Western Machinery and Steel World,* v. 37, July '46, p. 118-121.

Advantages; safe handling methods.

12-123. **Nondestructive Testing of Metal Parts.** R. L. Cavanagh. *Steel Processing,* v. 32, July '46, p. 436-440.

The DuMont cyclograph. Applications, with particular emphasis on high-speed sorting of small metal parts.

12-124. **Statistical Control in Manufacturing Steel Strips and Tin-Plate.** M. M. Armstrong. *Iron and Steel Engineer,* v. 23, July '46, p. 69-77.

Although only in operation for a few months, statistical control has improved over-all quality of tin-plate and reduced rejects to a marked degree.

12-125. **German Shipyard Welding.** *Welding,* v. 14, June '46, p. 286-287.

Abstract of report on radiography and magnetic inspection in German shipyards.

12-126. **Statistical Control Applied to Wrench Manufacture.** F. J. Robbins. *Metal Progress,* v. 50, Aug. '46, p. 287-290.

Application of statistical control to steel fabrication illustrated by manufacture of a flat wrench. Chain of mutually agreed upon specifications can link the user of a product to the producer of the raw material. For each specification tolerance limits can be set up in terms which control both the manufacturing process and the inspection method. These controls function as guides to quality, segregating unacceptable work.

12-127. **Crack Detection—Utility and Limitations of the Magnetic Method.** Donald Taylor. *Automobile Engineer,* v. 36, July '46, p. 319-321.

Principles of magnetic crack detection; methods; cyclic magnetization. Discrimination and judgment must be used in interpreting results, since revealed surface troubles are not necessarily cracks, the intensity of magnetization will influence an observation, and particle size of the powder in the ink will have an influence on observations.

12-128. **Modern Methods of Gear Inspection.** Don Moncrieff. *Machine Tool Blue Book,* v. 42, Aug. '46, p. 199-200, 202, 204, 206, 208, 210.

To insure accuracy in gears, it is necessary to inspect and control all factors relating to finished product, beginning with material. Either chemical analysis should be made of all steels received, or test pieces should be hardened out of each shipment. Such test pieces are inspected for heat treat distortion so allowances can be

made for gears run in regular production. Also necessary to control tooth profile; tooth spacing; helical lead and spur gear tooth alignment; size and concentricity.

12-129. **Precision Measurement, Section I, Part 2—Inspection Instruments. (Continued.)** Warren Baker. *Machine Tool Blue Book,* v. 42, Aug. '46, p. 129-130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156.

Accessories now available that have put true precision in the field of direct measurement, making gage blocks as versatile and handy to use as the machinist's rule.

12-130. **Gear Tolerances and Inspection Standards Evolve From War Production.** Granger Davenport. *Tool & Die Journal,* v. 12, Aug. '46, p. 92-94.

New American standard covers spur and helical gears, bevel and hypoid gears, and backlash in gears.

12-131. **Supersonic Waves for Detecting Cracks in Steel.** C. H. Desch, D. O. Sproule, and W. J. Dawson. Welding, v. 14, July '46, p. 321-328.

With equipment shown it appears that the varying hardness and microstructure of the thermally disturbed zone of the parent plate, and also the structure and analysis of the weld metal, do not cause any appreciable damping or reflection of the supersonic beam. Great advantage of the supersonic method of testing is that very thick welds are well within its scope, and it should thus be possible to reveal flaws which the radiographic method might not detect.

12-132. **Economic Control of Quality—a Symposium.** *Tool Engineer,* v. 17, Aug. '46, p. 18-35.

Quality Standards and Specifications, by Edward S. Marks; Fundamentals of Inspection Procedure, by Alfred L. Davis; A New Approach to Statistical Quality Control, by Joseph Manuele; Dimensional Control, by Paul V. Miller; Gages and Testing Equipment—an Exposition of Tools Used for Control of Dimensional Quality, by A. E. Rylander.

12-133. **Magnetic Testing of Metals.** P. E. Cavanagh, E. R. Mann and R. T. Cavanagh. *Electronics,* v. 19, Aug. '46, p. 114-121.

Correlation between magnetic properties (particularly remanent magnetism which predominates at the low test frequency that is used) and metallurgical properties makes possible the determination of composition and condition of ferromagnetic materials by magnetic testing. Operation, methods of indication, and application of test equipment are described.

12-134. **Substituting Rolls When Checking V-Block Dimensions.** Charles L. Hall. *Production Engineering & Management,* v. 18, Aug. '46, p. 60.

Expense incurred and time consumed in making odd-size gages for checking V-blocks can be eliminated by applying the formula given and substituting standard gages or rolls for checking.

12-135. **Checking Equipment for Precision Cut Gears.** John E. Hyler. *Production Engineering & Management,* v. 18, Aug. '46, p. 77-80.

Machines and methods for checking tooth spacing, the cone and taper of precision cut or shaved gears.

12-136. **Design, Construction, and Use of Some Inspection Gages.** L. H. Leedham. *Institution of Mechanical Engineers Proceedings,* v. 153, War Emergency Issue no. 4, '45, p. 133-140.

Descriptions are given of varied applications to gaging apparatus for different components, each of which presents a problem in inspection.

12-137. **Some Results of Advances in Welding and Radiography on the Welding of Pressure Vessels.** O. R. Carpenter. *Industrial Radiography,* v. 5, Summer '46, p. 9-17.

Radiographic technique as it pertains to pressure vessels. Brief facts concerning methods of welding today, type of defect with speculation as to its cause, and recently developed method of inspection.

12-138. **Gamma Radiography of Rail Welds in the Moffat Tunnel.** Ray McBrian and R. Wayne Parcel. *Industrial Radiography,* v. 5, Summer '46, p. 28-31.

Methods and techniques involved in making a large number of radiographs under rather adverse conditions.

12-139. **Stereoscopic Radiography.** Leslie P. Dudley. *Industrial Radiography,* v. 5, Summer '46, p. 23-25, 39.

Photographic method and radiographic methods subdivided into moving-tube methods and moving-subject methods. Each class of method and their relative advantages and disadvantages discussed. (Abstracted from *Light Metals,* June 1945.)

12-140. **Applications of X-Ray in the Design and Inspection of Chemical Warfare Service Material.** F. B. Shaw, Jr. and L. Benjamin. *Industrial Radiography,* v. 5, Summer '46, p. 32-35

Experience with magnesium incendiary bomb, smoke pots and mortar shells.

12-141. **Refinements in Supersonic Reflectoscopy. Polarized Sound.** Floyd A. Firestone and Julian R. Frederick. *Journal of the Acoustical Society of America,* v. 18, July '46, p. 200-211.

One form of simple circuit for the generation of the short duration high frequency voltage trains used in the supersonic reflectoscope is shown. Required band width of the system, including the crystal. Techniques for the radiation of longitudinal, shear, and Rayleigh waves. The instrument is used principally for inspecting the interior of a metal part for flaws by sending into the part a short train of supersonic waves and observing the reflections from any flaws.

12-142. **Fluoroscopic Inspection of Steel.** Gilbert C. Close. *Steel Processing,* v. 32, Aug. '46, p. 502-504.

Description of new machine. Advantages are: ease of control, eliminating operator fatigue; completely automatic control for transportation of parts into and out of viewing position, and for rotational viewing; simplified method for adjusting the distance between the viewing screen and part to secure image sharpness; new type

protective window with its "clear view" characteristics; more power, using X-ray tube with a small focal spot to increase image sharpness and definition.

12-143. **Probability and Quality Control. Part II.** Eugene Goddess. *American Machinist,* v. 90, Aug. 29, '46, p. 118-119.

Some of the applications of statistical quality control in modern machine-shop practice; how the controls operate.

12-144. **Supersonic Inspection of Materials.** H. R. Clauser. *Materials & Methods,* v. 24, Aug. '46, p. 379-384.

Reflection method and the through-transmission method. Inaudible sound waves are used to perform nondestructive inspection of materials to determine and locate voids and other type flaws. Both are able to penetrate thicker sections of materials such as steel and aluminum, and to locate accurately any discontinuities present.

12-145. **Electronic Gaging.** Paul H. Hunter. *Electronic Industries,* v. 5, Sept. '46, p. 68-71.

New standards of accuracy and speed in dimensional inspection are made possible by precision electronic instruments. Describes two types of electronic micrometers.

12-146. **The Interpretation of Radiographs of Spot Welds in Alclad 24S-T and 75S-T Aluminum Alloys.** Robert C. McMaster and Frederick C. Lindvall. *Welding Journal,* v. 25, Aug. '46, p. 707-723.

First of a series on spot weld radiography. Presents simple rules for the interpretation and evaluation of weld properties from spot weld radiographs.

12-147. **Supersonics in Metallurgy.** *Metal Industry,* v. 69, Aug. 16, '46, p. 136-138.

Deals with the progress made by the employment of supersonics in both the light and heavy engineering industries and the good results which, so far, have been obtained. Applications include lowering of the solidification temperature of metals, the tinning of aluminum, modifications in magnetic properties and increasing the chemical activity of metals.

12-148. **Report on Specifications for Materials.** *Railway Mechanical Engineer,* v. 120, Sept. '46, p. 459-460.

Withdrawal of certain piping and high-chromium steel specifications recommended; separation of carbon and carbon-silicon steel specifications recommended.

12-149. **Precision Measurement. Section 1—Inspection Instruments, Continued. Part 3—Optical Flats.** Warren Baker. *Machine Tool Blue Book,* v. 42, Sept. '46, p. 141, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174.

Theory and use of optical flats; examples.

12-150. **A Complete Quality Control Program.** Joseph Manuele. *Tool & Die Journal,* v. 12, Sept. '46, p. 91-93, 96-97, 168.

Program has resulted in better quality, increased production, and lower costs; is sufficiently flexible to be applicable in most manufacturing plants with comparable results.

12-151. **Experimental Work on the Production and Use of Radiographed Steel Castings for Service at High Pressures.** F. H. Keating. *Iron and Steel Institute Advance Copy,* Aug. '46, 8 p.

A practical experiment in the production of castings for use in handling fluids at 350 atm. pressure. Discusses economic and technical advantages attending use of castings for this class of duty, and emphasizes that the principal deterrent to their widespread use in this way is the uncertainty as to the soundness of a casting. Use of radiography to provide necessary assurance of soundness is tested on a number of castings, and results of the practical experiments are analyzed. Castings which passed the stringent acceptance tests were installed on high-pressure lines and their performance is under observation. Trial period of two years in service is visualized before any conclusions can be drawn.

12-152. **The Radiography of Spot Welds in Light Alloy and Ferrous Sheet Materials.** Robert C. McMaster and Frederick C. Lindvall. *Welding Journal,* v. 25, Sept. '46, p. 851-860.

In nearly all sheet materials, radiography provides sufficient information to be of value in spot weld process control. Indicates the useful range of application of spot weld radiography in light alloy and ferrous sheet materials and presents summary of tests using the following sheet materials: 24S-T alclad, 75S-T alclad, 61S-T, 61S-W, 52S-¼H and 3S-O aluminum alloys; J1-H and 52S magnesium alloys; 1010 zinc-coated, 1020, annealed and full hard 18-8 stainless and cadmium-plated X4130 steels; terne plate; and Inconel.

12-153. **Cracking in Service of 0.5% Molybdenum Steel Steam Piping.** *Engineer,* v. 182, Aug. 16, '46, p. 149-150.

Recommendations for prevention.

12-154. **Instrument Uses Supersonic Vibrations to Determine Quality Prior to Welding.** *Blast Furnace and Steel Plant,* v. 34, Sept. '46, p. 1147-1148.

Principles of operation of the Sperry supersonic reflectoscope, which can be used to give a qualitative indication of the concentration of segregations and inclusions along the welding edge.

12-155. **Advantages of N.E.M.A. Standardized Motors.** E. G. Wickersham. *Steel,* v. 119, Sept. 23, '46, p. 144, 146.

Besides reducing costs, standardization enables established machinery manufacturers to secure the same motor from several sources with confidence in performance and interchangeability.

12-156. **The Technique of Gamma Radiography.** R. Halmshaw. *Engineering,* v. 162, Aug. 23, '46, p. 169-170.

Practical problems encountered in developing a technique of gamma radiography based on five years' practical experience and on the experience of colleagues engaged on similar work.

12-157. **Tests or "Traditions"?** Fred P. Peters. *Scientific American,* v. 175, Oct. '46, p. 149-152.

Trend toward using the conventional standard test only

where it has significance, and developing simulated-service tests for evaluating application-performance where several complicated service factors are involved.

12-158. **Safety X-Ray Code Protects Workers.** *Steel,* v. 119, Sept. 30, '46, p. 81.

American Standards Association code covers requirements for installing, operating and maintaining X-ray and radium equipment.

12-159. **Mixed Metal Magic.** John Markus. *Electronics,* v. 175, Oct. '46, p. 169-171. Also *Scientific American,* v. 175, Oct. '46, p. 169-171.

Use of triboelectric sorter to identify jumbled alloy stock and parts. It utilizes the small current generated when dissimilar metals rub together. Use of direct-reading spectrometer in steel mill operation.

12-160. **The Economics of Industrial Radiography.** Lynn Brown. *Western Metals,* v. 4, Sept. '46, p. 21-22.

Advantages; fields of use; savings made possible; types of equipment for different applications.

12-161. **High-Speed Vibrations Utilized in Testing Device for Welding Plates.** *Western Metals,* v. 4, Sept. '46, p. 39-40.

Sperry supersonic reflectoscope is capable of giving a qualitative indication of the concentration of segregations and inclusions along the welding edge.

12-162. **Supersonic Flaw Detector.** *Canadian Metals and Metallurgical Industries,* v. 9, Sept. '46, p. 31, 42.

Method of nondestructive testing for detection of flaws in iron, steel, and nonferrous metals.

12-163. **Gear Tooth Wear and Failure.** *Machinery (London),* v. 69, Sept. 12, '46, p. 329-332.

Information concerning nomenclature standard adopted by the American Gear Manufacturers. Prime object of this standard is to describe terms used to explain different types of tooth wear and failure

12-164. **The Case for 100% X-Ray Aircraft Castings.** Justin G. Schneeman. *Iron Age,* v. 158, Oct. 10, '46, p. 56-58.

Combining radiographs with fluoroscopic examination. Stresses the relationship between safety and adequate inspection procedures and examines in detail the erroneous assumptions involved in percentage examinations.

12-165. **Supersonic Plate Testing.** Clyde B. Clason. *Welding Engineer,* v. 31, Oct. '46, p. 42-43.

Details of a new instrument which uses supersonic vibrations to determine plate quality prior to welding. Plates with sulphide inclusions are thus avoided.

12-166. **Black Light for Weld Inspection.** Sanford Markey. *Modern Machine Shop,* v. 19, Oct. '46, p. 192, 194, 196, 198.

How black light is used to detect minute defects in welds in aircraft heaters.

12-167. **Interpreting Spot Weld Radiographs.** Robert C. McMaster. *Steel,* v. 119, Oct. 14, '46, p. 104-107.

Rapid and reliable inspection of spot welds for strength and quality is readily conducted with recently developed

radiographic techniques. Interpretation charts are presented as a guide for industrial use.

12-168. **Determining Plate Quality Before Welding.** *Steel,* v. 119, Oct. 14, '46, p. 120.

Experiments with new instrument using supersonic vibrations indicate segregations and inclusions along welding edge can be detected easily on plates 1½ in. and larger.

12-169. **Precision Measurement. Section I—Inspection Instruments. (Continued.) Part 4.** Warren Baker. *Machine Tool Blue Book,* v. 42, Oct. '46, p. 161-162, 164, 166, 168, 170, 172, 174, 176-178, 180-181.

Measuring machines.

12-170. **Quality Control as a Management Tool.** T. D. Foy. *Machine Tool Blue Book,* v. 42, Oct. '46, p. 217-218, 220, 222, 224, 226, 228, 230.

Factors involved in controlling quality; what is meant by quality control; purpose of quality control organization; type of organization for quality control.

12-171. **Standard Specifications.** G. M. Hutt. *Metal Industry,* v. 69, Sept. 27, '46, p. 255-258.

Principles of preparation for aluminum alloys, mechanical properties, chemical composition, dimensions, other requirements; form of specifications; amendments and revisions; index; D.T.D. specifications. 2 ref. (To be concluded.)

12-172. **Recent Developments in Gear Inspection Methods.** Don Moncrieff. *Instruments,* v. 19, Oct. '46, p. 586-588.

Control of material; tooth profile; tooth spacing; helical lead and spur gear tooth alignment; size; concentricity.

12-173. **Hydraulic Operation and Electric Control Utilized in Conveyerized Multiple-Spindle Pneumatic Gage.** *Instruments,* v. 19, Oct. '46, p. 601-602.

Brief description of automatic instrument for simultaneously gaging bore diameters of an automobile cylinder block. Entire gaging job takes less than 60 sec. Checks for diameter, taper and out-of-roundness of eight cylinder bores of an engine block at four different points in each cylinder, and classifies them to 0.0003 in.

12-174. **Steel Building Code Changes Analyzed.** T. R. Higgins. *Engineering News-Record,* v. 137, Oct. 17, '46, p. 127-131.

Details of several changes in American Institute of Steel Construction specifications for structural steel buildings.

12-175. **The Application of the Cyclograph to Nondestructive Inspection of Materials, in Particular, Wire Rope.** O. W. Ellis. *Wire and Wire Products,* v. 21, Oct. '46, p. 776-777, 780-783.

Interim report on work now being carried out at the Ontario Research Foundation by the incumbent of the DuMont Fellowship.

12-176. **Standard Specifications—Principles of Preparation for Aluminum Alloys.** G. M. Hutt. *Metal Industry,* v. 69, Oct. 4, '46, p. 281-282.

Discusses the methods of preparing and establishing

British Standards, touching lightly on standards and specifications of other countries.

12-177. **X-Rays in Steel and Iron.** Eric N. Simons. *British Steelmaker,* v. 12, Oct. '46, p. 500-503.

Principles of X-ray and electron diffraction; how these methods are used for inspection of metals for flaws.

12-178. **Modern Gear Inspection.** *Steel,* v. 119, Oct. 28, '46, p. 82, 84, 132.

Machines and procedure for checking tooth profile, tooth spacing, helical lead and spur gear tooth alignment, size and concentricity.

12-179. **Fluoroscopy of Aluminum.** Gilbert C. Close. *Light Metal Age,* v. 4, Oct. '46, p. 14-17.

Advantages and disadvantages; machines now available; results of recent investigations of 2000 aluminum castings.

12-180. **Gaging by Optical Projection.** *Tool & Die Journal,* v. 12, Oct. '46, p. 90.

By projecting an accurately magnified shadow, the optical projection comparator provides the means for seeing and measuring "split thousandths." When scientifically coordinated, staging fixtures and chart-gages are used with it. Forms the basis for more rapid and accurate inspection and for fuller utilization of other applications of optical projection in maintaining control of both tooling and production. Solution to a metal stamping problem is shown.

12-181. **Radiographic Inspection of Magnesium Alloy Castings.** E. R. Yarham. *Modern Machine Shop,* v. 19, Nov. '46, p. 138-140, 142, 144, 146, 148, 150, 152.

Discussion of the methods employed by two English firms.

12-182. **Radiographic Inspection Fits Into Work Processing Schedules.** Rupert Le Grand. *American Machinist,* v. 90, Nov. 7, '46, p. 134-137.

Prompt, economical surveys of castings and weldments are made when X-ray installations are planned for quick handling of work, film and defect analysis.

12-183. **Graphical Solutions of Statistical Problems.** F. Levi. *Engineer,* v. 182, Oct. 18, '46, p. 338-340; Oct. 25, '46, p. 362-364.

Various examples are used to illustrate the use of "probability graph paper" in determination of sample size for inspection of industrial products.

12-184. **The Punched Card Identification of Ore Minerals.** Ernest E. Fairbanks. *Economic Geology,* v. 41, Nov. '46, p. 761-768.

Punched cards have definite value in identification work especially where X-ray diffraction or other advanced methods are not available. Suggestions are offered for the preparation of a card set having diagnostic value. One card is prepared for each sufficiently described mineral. The punches indicate color, cleavage, tenacity, optical properties, hardness, chemical reactions, elements present, and specific gravity ranges. 24 ref.

12-185. **Buick's Advanced Practice in Inspection of Cylinders.** *Machinery,* v. 53, Nov. '46, p. 176-183.

Inspection machines that gage cylinder bores simultaneously at 32 points and classify them for selective assembly with matched pistons are used in the Buick production line. Boring, honing, and finishing operations performed on these close-tolerance bores are described.

12-186. **Control of Quality in Steel Manufacture.** A. O. Schaefer. *Metal Progress,* v. 50, Nov. '46, p. 815-819, 822.

Quality control in steelmaking considered in two phases —recognition and control of the factors of manufacture and tests and inspection. Most important objective is uniformity of product, only attained by positive control as described.

12-187. **Microradiography With Routine X-Ray Equipment.** Edward I. Salkovitz. *Metal Progress,* v. 50, Nov. '46, p. 1091-1096.

Theoretical considerations: examples of use and limitations; preparation of sample and choice of film, developer and enlargement; microradiography versus photomicrography.

12-188. **The Quantitative Interpretation of Radiographs in Terms of Mechanical Properties.** L. R. Carr. *Journal of Scientific Instruments,* v. 23, Oct. '46, p. 221-227.

Various types of defects and their appearance in the radiograph or photomacrograph are described and illustrated. Investigation attempts to answer the question, "Is it possible to make a reliable judgment from the radiograph of the degree to which a defect is present, and can the judgment be correlated with the mechanical properties of the material?" Tensile test pieces were cut from areas showing various radiographic characteristics, and tested. Results show definite correlations, but also the need for much more work on the problem.

12-189. **Applying Quality Control Effectively.** T. D. Foy. *Machine Design,* v. 18, Nov. '46, p. 127-130.

A long-range approach which will assure successful quality control by providing adequate corrective action against variations which are the outgrowth of new designs, new materials, new processes, methods, machines, etc., is outlined. (Presented at the A.I.E.E. summer convention held in Detroit.)

12-190. **On the Relation of Instrumentation to Quality Control.** Leslie E. Simon. *Instruments,* v. 19, Nov. '46, p. 654-656.

Primary sources of error or variation in measurement: errors of the operator and of the instrument; variations in the product being measured. Also covers product variation, importance of instrument calibration, relation of instrument variation to product variation, and analytical separation of sources of variation. The application of these principles to the problem of acceptance testing of ammunition is detailed.

12-191. **20 Million Volt Betatron for Industrial Radiography.** *Iron Age,* v. 158, Nov. 21, '46, p. 60-61. Also *Steel,* v. 119, Nov. 25, '46, p. 68-69, 92.

Features of betatron, which permit production of high quality radiographs rapidly and with low cost, are deep penetrating power, sharp focus and speed. These fea-

tures are said to make this unit competitive, from an over-all viewpoint, with 1 and 2-million volt machines.

12-192. **Planned Simplified Inspection.** Philip G. Fishback. *Tool Engineer,* v. 17, Nov. '46, p. 30-34.

Two fundamental principles—a sound foundation and interdepartmental cooperation—determine the efficiency of the inspection department.

12-193. **"Blow-Up" Photos Facilitate Research and Inspection.** M. W. Seavey. *Tool Engineer,* v. 17, Nov. '46, p. 45-48.

Photographing contour projections on optical comparator assists in the control of quality.

12-194. **Bestamning av Kornstoriek has Mjuka Stal. (Determination of Grain Size in Mild Steels.)** B. D. Enlund and G. Schlberg. *Jernkontorets Annaler,* v. 130, no. 8, '46, p. 273-284.

Grain size chart based on actual micrographs which were traced over and reproduced in different magnifications. Conversion of the scale to A.S.T.M. scale may be made by formula.

12-195. **Quality Control of Steel Gear Parts.** *Tool & Die Journal,* v. 12, Nov. '46, p. 93-94, 114-B.

Case history of problem involving grinding job held to tolerances of ± 0.0005 in. Questions presented were: Can quality control method provide some way by which not even one defective piece reaches the truck assembly line, and can this result be secured and one-third of inspection expense be eliminated?

12-196. **Nondestructive Magnetic Inspection of Steel.** R. L. Cavanagh. *Steel Processing,* v. 32, Nov. '46, p. 730-732, 737.

Operation and application of the "Ferrograph", an instrument operating on the transformer principle.

12-197. **Supersonic Flaw Detector.** *Electronics,* v. 19, Dec. '46, p. 198, 202, 206, 210, 212.

Method adopted by Germans for flaw detection in metals that cannot be tested by X-ray or magnetic methods. Method uses a quartz crystal as a generator, with frequency wobbled 100 cycles to avoid standing waves in the test sheet or between the transmitter and receiver. Vibrations pass through a metal block chamber. Makes contact with sheet being tested by means of rollers which maintain the gap constant at 0.5 mm.

12-198. **Statistical Control Cuts Scrap Cost 88%.** Clifford W. Kennedy. *Factory Management and Maintenance,* v. 104, Nov. '46, p. 102-105.

Scrap and rework pieces down 88%; direct inspection cost down 90%; hours per unit improved; production leveled out and increased.

12-199. **Practical Tool Inspection and Quality Control Methods.** D. P. Walsh. *Tool Engineer,* v. 17, Dec. '46, p. 29-34.

Applies magnaflux and Zyglo techniques to the inspection of perishable tools.

12-200. **Tools and Statistical Quality Control.** A. A. Goodman. *Tool Engineer,* v. 17, Dec. '46, p. 40-43.

Cites two examples—elimination of tool breakage and

significance of variance between pigfuls and within jigfuls —to indicate the close tieup that statistical quality control can have with the tool engineer, thus leading to better methods and equipment.

12-201. **Sampling Techniques Applied to Quality Control.** Eugene Goddess. *Iron Age,* v. 158, Dec. 12, '46, p. 70-75, 136A.

How to make a proper sampling and select an optimum sample size from the point of view of practicality and statistical accuracy.

12-202. **Location of Internal Defects by Supersonics.** J. W. Dice. *Instruments,* v. 19, Dec. '46, p. 718-722.

Principle of operation of the Sperry supersonic reflectoscope. Pattern on an oscilloscope screen provides a visual indication of the location of any defects that may be present in the material.

12-203. **Tapering for Surface Inspection.** W. J. Darmody. *American Machinist,* v. 90, Dec. 19, '46, p. 134-135.

Taper sectioning is performed by grinding and lapping a tapered area on the surface to be analyzed. Section should be deep enough to remove all traces of the machine surface finish at the lowest point and should make only a slight angle with the surface—between 1° and 2½°.

12-204. **X-Raying Turbine Parts.** J. A. Pratt. *Steel,* v. 119, Dec. 23, '46, p. 60-61, 102.

Methods used at South Philadelphia works of Westinghouse where 1000-kv. and 220-kv. X-ray machines and radium capsules are used.

SECTION XIII

TEMPERATURE MEASUREMENT AND CONTROL (PYROMETRY)

13-1. **Combustion Protective Controls.** D. A. Campbell. *Instruments,* v. 18, Dec. '45, pp. 868-873.

Discusses combustion protective devices as applied to combustion practices in connection with combustion of commonly used fuels, such as coal, oil, gas, and combinations of these.

13-2. **Measuring Devices for Atmosphere and Combustion.** *Industrial Heating,* v. 12, Dec. '45, pp. 2082, 2084, 2086, 2088.

Process and combustion-gas analyzers; dew point potentiometer and recorder; flow meters; furnace pressure meters and controls; gas mixing and ratio control.

13-3. **Automatic Indicating Recorder for Analyzing Combustibles.** *Industrial Heating,* v. 12, Dec. '45, pp. 2190, 2192.

Has been successfully applied to precision control of furnace atmospheres and chemical processes, as well as combustibles measurements in the metallurgical, chemical, petroleum and automotive industries.

13-4. **The Effect of Measurement Dead Time in the Control of Certain Processes.** Donald P. Eckman. *Steel Processing,* v. 31, Dec. 45, pp. 779-783.

Tests with two-position control; tests with proportional-reset control. Desirable to maintain measurement dead zone as small as possible since it increases the quality of control by accomplishing a reduction of dead time. 5 ref.

13-5. **Pyrometry.** H. J. Smith. *Metal Industry,* v. 67, Dec. 14, '45, pp. 395-397.

Wartime developments in instruments and control.

13-6. **Pyrometry.** H. J. Smith. *Metal Industry,* v. 67, Dec. 21, '45, pp. 415-417.

Desirable control factors; multi-point control; proportional control; coordination of time and temperature; comparison of pyrometers.

13-7. **Flame-Temperature Measurements in Internal-Combustion Engines.** O. A. Uyehara, P. S. Myers, K. M. Watson and L. A. Wilson. *Transactions of the American Society of Mechanical Engineers,* v. 68, Jan. '46, p. 17-28, discussion p. 28-30.

Theory, development, and calibration of an electro-optical pyrometer, capable of determining instantaneous true temperatures of luminous flames. Description is also given of auxiliary apparatus used with the electro-optical pyrometer to obtain simultaneous values of pressure, temperature, and crank position in an internal-combustion engine. Typical data obtained with this instrumentation as applied to a diesel engine. 23 ref.

13-8. **Instrumentation and Process Control.** Harold A. Knight. *Materials and Methods,* v. 23, Jan. '46, p. 151-152.

Anticipating furnace control; pyrometers; other controls.

13-9. **Importance of Fundamentals in Automatic Control.** Donald P. Eckman. *Industrial Heating,* v. 13, Jan. '46, p. 53-54, 56, 58, 60, 62, 64, 68, 72.

In nearly all cases discussed the controlled variable is temperature. Applies in general, however, to the control of pressure, flow, and liquid level when allowances are made for the greatly different process characteristics. Action of control responses; process characteristics affecting control; process reactions; practical aspects of control; reduction of dead zone; instrument accuracy and installation of element; control valves; outside variables; product control.

13-10. **Instrumentation of Annealing Furnaces.** J. P. Vollrath. *Instrumentation,* v. 2, Jan-Feb. '46, p. 25-26.

Two basic systems for automatic control of radiant tube annealers; shows conventional panel board arrangements for 16 bases and four covers.

13-11. **Temperature Measurement by Means of an Immersion Pyrometer.** E. Hunter, A. R. Parkes and J. W. Dews. *Foundry Trade Journal,* v. 78, Jan. 17, '46, p. 53-60.

Requirements of measuring equipment; types of potentiometer; method employed; assembling the couple; cold junction; obtaining final balance; procedure of taking readings; direct reading temperature scales; necessity for temperature control.

13-12. **Gas Turbine Takes Its Own Temperature.** *Blast Furnace and Steel Plant,* v. 34, Feb. '46, p. 264-265.

Through use of a special metal alloy which tells temperature by color, the alloy, a chromium-cobalt composition, shows a marked color change for every 25° change in temperature from 500 to 700° C., then reverts back to its original color and begins the color scale over again in a higher range of from 725 to 900° C. (1652° F.).

13-13. **Recent Developments in the Pyrometry of Liquid Iron and Steel.** H. T. Clark. *Iron and Steel Engineer,* v. 23, Feb. '46, p. 55-63, 80.

Past and present methods; results obtained. Tungsten-molybdenum thermocouple; tungsten-graphite; carbon, silicon carbide; platinum, platinum-rhodium. Radiation methods—pyrometers. Quick immersion platinum thermocouple and open-end tube immersion pyrometer are designed for routine use in steel mill and meet requirements of practicality as well as accuracy and reliability.

13-14. Standardization of Temperature and Electrical Measurements. Eugene Goddess. *Product Engineering,* v. 17, March '46, p. 212-215.

Methods of maintaining the basic units of temperature measurement as defined for the International Temperature Scale and also the fundamental electrical measurement standards. Characteristics of resistance thermometers, thermocouples and optical pyrometers are discussed with a description of calibrating procedures.

13-15. Development of the Measurement of Openhearth Bath Temperatures. *Industrial Heating,* v. 13, April '46, p. 682-685, 698.

Steps taken to improve Collins-Oseland method.

13-16. Improved Measurements for Industrial Processes. Douglas M. Considine and Donald P. Eckman. *Steel,* v. 118, May 20, '46, p. 114-116, 133.

Some of the newer electronic instruments: electronic potentiometers; Geiger counter X-ray spectrometer.

13-17. Methods for Measuring the Temperature of Liquid Steel in the Openhearth Furnace. V. S. Kotsho. *Engineers' Digest (American Edition),* v. 3, April '46, p. 169-170.

A special thermocouple consists of a jacket made of a piece of thick-walled steel tubing having a thickened endpiece to be immersed in the bath. The tip is made of steel but can also be made of refractory material or graphite. In the head of the device a stopper is arranged through which a thin metal tube passes, which contains the thermocouple proper. The hot junction of the thermocouple, which projects some 90 mm., is protected by a thin quartz tube affixed to a holder of special design. Platinum, platinum-rhodium and tungsten-molybdenum couples were used, with best results from the former because of its large electromotive force and stable electric characteristics.

13-18. The Design and Performance of Some Commercial Optical Pyrometers of the Disappearing-Filament Type. C. R. Barber. *Metallurgia,* v. 33, April '46, p. 305-306.

Critical examination has been made at the National Physical Laboratory of five models of commercial portable optical pyrometers of the disappearing-filament type, with reference to the design of the lamp, the optical system, the monochromatic and neutral filters, and the measuring system. (Paper for the Steel Castings Research Committee of the Iron and Steel Institute.)

13-19. Liquid Metal Temperatures. H. T. Clark. *Iron and Steel,* v. 19, May '46, p. 197-200.

Description of two types of immersion thermocouple.

13-20. Optical Pyrometers—the Design and Performance of Some Commercial Disappearing-Filament Types. C. R. Barber. *Iron and Steel,* v. 19, May 10, '46, p. 246-250.

Five models examined. In four of them the combined effect of the various defects is to cause uncertainties of measurement of about $\pm 10°$ C. on the low range and $\pm 20°$ on the high range. In the fifth instrument the uncertainty was about $\pm 3°$ C. on the low range.

13-21. **Bimetallic Strip.** *Metal Industry,* v. 68, May 31, '46, p. 427-428.

Production methods used by two German manufacturers of bimetals for thermostatic purposes. Rau methods using 15% nickel, 5% manganese steel high-expansion element, and Heraeus practice using 25% nickel, 5% molybdenum steel and a 20% nickel, 6% manganese steel.

13-22. **A Heat-Flow Meter for Use in Furnaces.** R. H. Baulk and M. W. Thring. *Iron and Steel Institute Advance Copy,* May '46, 26 p.

It was desired to measure the heat transfer by radiation and convection from the flame to the charge and to the furnace walls. The work on such an instrument has reached a stage where a practical research tool has been evolved and used to compare the heating power of different flames, to examine the effect of flame thickness upon the heat flow from the flame, and to compare the heat flow at different points along and across the flame.

13-23. **A Radiation Pyrometer for Openhearth Bath Measurements.** H. T. Clark and S. Feigenbaum. *Metals Technology,* v. 13, June '46, T. P. 2031, 13 p.

A radiation pyrometer, which offers certain advantages with respect to ease of operation, maintenance and reliability, has been developed and tested extensively under plant conditions. The instrument employs a radiation device, mounted inside an open-end steel tube, sighted on the liquid steel. Compressed air keeps the orifice free from molten slag and steel. In the course of the work, a convenient method was devised for standardizing the pyrometer to insure continued accuracy in mill use.

13-24. **Humidity Measurement and Control in Steel and Allied Industries.** O. J. Leone. *Iron and Steel Engineer,* v. 23, June '46, p. 100-111; discussion p. 111-112.

Effects of moisture on several processes, various control methods used; several new and more direct methods of measurement and control of humidity values.

13-25. **Improvement in Design of Immersion Pyrometers for Liquid Steel Temperatures.** D. Manterfield and J. R. Thurston. *Iron and Steel Institute Advance Copy,* June '46, 5 p.

An improved design of immersion thermocouple, consisting of a semipermanent fixture attached to the backwall furnace binding and manipulated through the backwall of the furnace by means of a light jib.

13-26. **Automatic Furnace Control.** *Iron and Steel,* v. 19, June '46, p. 395-396.

New method for solid fuel furnaces. The method consists of three essential sections. The first measures the temperature of the furnace, and regulates the air flow accordingly. The second measures the air flow, and the third times and controls the fuel feed.

13-27. **Recent Developments in Pyrometry of Liquid Iron and Steel.** *Industrial Heating,* v. 8, July '46, p. 1151-1158.

Tungsten-molybdenum thermocouples; tungsten-graphite thermocouples; carbon silicon carbide thermocouples; platinum thermocouples; radiation-type measuring means.

13-28. **Temperature Measurement of Liquid Steel.** D. Manterfield. *Iron Age,* v. 158, July 25, '46, p. 52-57.

Reviews progress of liquid steel pyrometry in Britain and describes in detail the latest type of immersion thermocouple equipment.

13-29. **Temperature Uniformity in Heating-up Processes.** M. P. Heisler. *Transactions of the American Society of Mechanical Engineers,* v. 68, July '46, p. 493-500; discussion p. 500-502.

The treatment of temperature-uniformity problems by the method first introduced by Paschkis is extended and enlarged. It is shown that uniformity calculations can be reduced to the solution of a simple trigonometric relation which can be readily solved and analyzed. Standard Gurney-Lurie charts for cylinders and spheres are given in a more complete form than is available at present. A chart is included for determining temperature history in plates subjected to two-dimensional heat flow. Finite cylinders are discussed and three-dimensional heat-flow problems are briefly considered.

13-30. **Direct Temperature Measurement.** *Iron and Steel,* v. 19, July '46, p. 451-452.

German thermometer for use at 1000° C.

13-31. **Methods of Temperature Measurement of Liquid Iron and Steel.** H. T. Clark. *Electric Furnace Steel Proceedings A.I.M.E.,* v. 3, 1945, p. 81-87.

Describes some of the techniques used for measuring the temperature of liquid iron and steel. Discussion. 10 ref.

13-32. **Principles of the "Black Body Optical Pyrometer" and Instructions for Its Use.** K. L. Clark. *Electric Furnace Steel Proceedings A.I.M.E.,* v. 3, 1945, p. 88-94; discussion, p. 94-99.

Sighting tube equipment for use with conventional optical pyrometer extends applicability of latter. Temperature measurements are taken by sighting on the internal surface of a closed silica tube which is immersed in the molten metal to a depth three to five times its internal diameter.

13-33. **Hot-Dip Galvanizing Practice. (Continued.)** William H. Spowers, Jr. *Steel,* v. 119, Sept. 9, '46, p. 136-138, 140, 155.

Pyrometry in hot galvanizing. Modern installation of four recording potentiometer pyrometer controllers of the air-operated throttling type is shown.

13-34. **New Recorder for Machine Temperatures.** Hudson S. Day. *General Electric Review,* v. 49, Sept. '46, p. 30-32.

A small, simple and relatively inexpensive recorder which is satisfactory for measuring the relatively low temperature found in the windings of electric motors, generators and transformers, when resistance thermometers are used. Other applications mentioned. Not a high-precision method.

13-35. **Automatic Control of Furnace Temperature and Pressure.** *Engineer,* v. 182, Oct. 11, '46, p. 321-322.

Details of two pieces of apparatus recently introduced commercially in England. The temperature controller uses a thermocouple emf., which is converted to a mechanical pressure directly proportional to the deflection of a galvanometer pointer. The pressure controller depends upon achieving a considerable amplification of the small pressures which are to be measured. In both cases the final control device is a robust pressure instrument of standard design and proved performance with a range of 1 to 5 lb. per sq. in.

13-36. **Control Systems for Forging Furnaces.** J. P. Vollrath. *Instrumentation,* v. 2, Sept-Oct. '46, p. 29-30.

Details of Brown control systems for slot-type, rotary hearth, pusher-type continuous and large batch-type forging furnaces.

13-37. **The Effect of Measurement Dead Time in the Control of Certain Processes.** D. P. Eckman. *Transactions of the American Society of Mechnical Engineers,* v. 68, Oct. '46, p. 707-710; discussion, p. 710-711.

Reports on a series of automatic-controlled tests which demonstrate the importance of instantaneous controller-mechanism response in self-balancing potentiometer controllers. The automatic control tests were made with both two-position and proportional-reset control. Other tests, dealing with the importance of measurement dead zone of the controller, are included, noting the relation between dead zone of measurement and dead time of controller response.

13-38. **Measuring Instrument.** *Electronics,* v. 19, Nov. '46, p. 103-104.

Operating efficiency of openhearth steel furnace can be checked quickly with highly stable bridge-type battery-operated vacuum-tube voltmeter connected to a radiation pyrometer that can be aimed at any desired portion of the 4000° flame.

13-39. **A Simple Automatic Furnace Temperature Control.** E. Leighton Yates. *Journal of Scientific Instruments,* v. 23, Oct. '46, p. 229-231.

A simple control with a platinum resistance thermometer in one arm of an a. c. bridge. Out-of-balance potential is amplified, limited and applied to the grid, which is fed from an a. c. supply. The a. c. anode current of the output pentode is used to operate a thermal relay, which controls the furnace current. Instrument is equally sensitive at all temperatures between 0 and 1000° C., stable, portable, and inexpensive, and controls the temperature of an annealing furnace to less than $\pm$ 0.5° C. over the whole temperature range, the sensitivity depending on the design of the furnace and the resistance thermometer. Also describes a simple method of reducing or increasing the furnace temperature slowly with time.

13-40. **Factors Affecting the Reproducibility of Brightness of Tungsten Strip Lamps for Pyrometer Standardization.** C. R. Barber. *Journal of Scientific Instruments,* v. 23, Oct. '46, p. 238-242.

A quantitative examination of the effect of experimental

conditions. Unless certain precautions are observed appreciable differences in brightness may occur as a result of gradients of temperature in the lamp filament and of ambient temperature changes. Owing to the incidence of the Thomson effect it is important to insure that a consistent lamp polarity is maintained. The effect of reflections from the glass envelope of the lamp is considered and the most satisfactory sighting conditions determined to minimize this effect. In a gas-filled lamp, convective cooling of the filament necessitates precise positioning of the lamp relative to the vertical.

13-41. **Characteristics of Thermocouples.** C. T. Weller. *General Electric Review,* v. 49, Nov. '46, p. 50-53.

Temperature vs. emf., departure limits, operating ranges, and applications of five principal types are tabulated and charted.

13-42. **Temperature Control of Enameling Furnaces.** A. I. Andrews. *Finish,* v. 3, Dec. '46, p. 22-23, 52, 56.

Types of thermocouples; calibration; homogeneity; welding; optical pyrometers; radiation pyrometers; melting point salts.

13-43. **The Measurement of Gas Temperature.** G. F. Hubing. *Journal of the American Society of Naval Engineers,* v. 58, Nov. '46, p. 573-585.

Factors other than pyrometer indications which must be considered in determining actual gas temperatures are evaluated. Equations derived and sample calculations presented to correct the readings taken in a duct containing gas in motion.

13-44. **Measurement of Tool-Tip Temperature.** *Engineering,* v. 162, Nov. 8, '46, p. 435-436.

Details of an improved method based on the principle that the tool tip and the work it is cutting constitute the two elements of a thermojunction in which the leads consist of long, continuous, ribbon turnings from the steel sample under investigation. (Abstracted from "A Method for Measuring Tool-Tip Temperature" by Bert A. Crowder. Engineering Experiment Station, University of Minnesota. Technical Paper no. 55, June 1946.)

13-45. **Photographic Photometry Applied to the Measurement of Liquid Steel Temperatures.** J. Ainger Hall. *Photographic Journal,* v. 86B, Sept-Oct. '46, p. 117-131; discussion, p. 131-132.

Method used was to photograph the steel stream and a series of four standard sources of temperature on the same 16-mm. film. In this way, calibration data are available on each frame of the film. Various sources of error inherent in the method are discussed, and the experiments which were made in order to arrive at suitable corrections are described. It is believed that an accuracy of $\pm 10°$ C. in the 1500° C. region has been attained. Possible improvements in the technique suggested.

13-46. **Thermostatic Bimetals.** C. F. Alban. *Machine Design,* v. 18, Dec. '46, p. 124-128.

Design of actuating elements for temperature responsive

devices. Various thermostatic devices; correct use of bimetals.

13-47. **Basic Design of Thermowells.** George R. Feeley. *Machine Design,* v. 18, Dec. '46, p. 143-145.

Standardized thermowells assist in eliminating unnecessary fabrication costs and production problems involved with unorthodox and sometimes needlessly complicated designs. (Paper presented at the recent Instrument Society Conference.)

13-48. **Heat Flow.** R. H. Baulk and M. W. Thring. *Iron and Steel,* v. 19, Nov. 21, '46, p. 654-664.

Meter for use in furnaces and results of its use in various locations, together with illustrations and design features of furnaces.

13-49. **Liquid Steel Temperatures.** D. Manterfield and J. R. Thurston. *Iron and Steel,* v. 19, Nov. 21, '46, p. 695-697.

Improvement in design of immersion pyrometer. New type of arm and end block has helped to simplify the operation of temperature measurement, considerably cut down maintenance and reduced embrittlement troubles.

SECTION XIV

FOUNDRY PRACTICE AND EQUIPMENT

14-1. The Gating and Feeding of Steel Castings. S. T. Jazwinski, E. D. Wells, and S. L. Finch. *Foundry Trade Journal,* v. 77, Nov. 22, '45, pp. 245-252.

Bottom gating and top feeding; top gating and top feeding; step gating and top feeding; gating through a whirlhead; speed of metal supply to actual casting; general description of gating and feeding; supply of liquid steel from a feeder head; solidification of an open-type gravity or whirlgate head; solidification of a blind whirlgate head.

14-2. A New Method of Investigating the Behavior of Charge Material in an Iron Foundry Cupola, and Some Results Obtained. N. E. Rambush and G. B. Taylor. *Foundry Trade Journal,* v. 77, Nov. 22, '45, pp. 253-257.

Cause of lining wear; slag ledges; metal slag interface; carbon pickup; sulphur pickup; precise causes and interpretation; charge separation; coke burning; effect of slag ledges; future experiments; test-bar comments.

14-3. Centrifugally Cast Aircraft Parts. J. F. B. Jackson. *Aircraft Production,* v. 7, Nov. '45, pp. 511-513.

Application of process to irregular and asymmetrical units in high tensile alloy steel.

14-4. A New Method of Feeding Applied to Castings Made in Static Molds. S. T. Jazwinski. *Foundry Trade Journal,* v. 77, Nov. 29, '45, pp. 269-274.

Increasing the pressure in the feeder head to that of centrifugal casting increases the yield in static casting. Many examples of castings made by this method given. Method of introducing the compound which evolves gas and heat in the head; control of applied pressure; method of delaying the action of gas pressure; type of cavity formed. 2 ref.

14-5. The Gating and Feeding of Steel Castings. S. T. Jazwinski, E. D. Wells and S. L. Finch. *Foundry Trade Journal,* v. 77, Nov. 29, '45, pp. 277-280.

It was found that a head of 3.5 in. dia., 8 in. high, would successfully feed a 4-in. cube. Any reduction in diameter or height (keeping one of the dimensions constant) resulted in a shrinkage cavity in the cube. When the surface area of the head is reduced to a minimum in order to re-

duce radiation losses, a more spherical head will result in a further saving of 30% head metal. The development of optimum neck size was made using the test cube of 4 in. Minimum neck was 1⅞ in. thick, and its sectional area was equivalent of 40%, the thickest sectional area of the head. This proportion results in heads which cannot be knocked off and require removal in some other manner. 6 ref.

14-6. **Methods Employed to Obtain Rates of Solidification.** K. L. Clark. *American Foundryman,* v. 8, Dec. '45, pp. 24-25.

Mold preparation; chill practice; melting procedure; pouring; timing solidification; skin measurements; mold temperatures.

14-7. **Studies on Solidification of Castings.** Victor Paschkis. *American Foundryman,* v. 8, Dec. '45, pp. 26-37.

Solidification variables; comparative experiments; investigation material; temperature-time relationships; discussion of results; modifications of electrical analogy method when applied to casting freezing problems; heat balance between steel and sand. 14 ref.

14-8. **A New Method of Feeding Applied to Castings Made in Static Molds.** S. T. Jazwinski and S. L. Finch. *Foundry Trade Journal,* v. 77, Dec. 6, '45, pp. 293-303.

Results at varying pressures; production of castings using the gas-pressure head; application to heavier castings; comparison between gas-pressure feeding and other static methods; exothermic reaction; weight of runner and head metal.

14-9. **Casting Magnesium.** M. M. Moyle. *Western Machinery & Steel World,* v. 36, Dec. '45, pp. 542-546, 587.

Sand casting; permanent mold casting; heat treatment; die casting.

14-10. **Gating, Heading and Chilling of Aluminum Castings.** Charles G. Gribble. *Western Metals,* v. 3, Dec. '45, pp. 25-26.

Sands, cores, gates, risers and chills.

14-11. **Cleaning Castings by the Hydro-Blast System.** *Machinery (London),* v. 67, Dec. 13, '45, pp. 672-674.

Using water and sand as cleaning medium. Hydro-blast system rapidly removes hardest and most complicated cores, and scours and blasts all surfaces clean. Sand-chipping operations by hand are eliminated, and core and molding sand normally wasted are returned in a new condition. Sand blasted from the castings is circulated through the system and used as the abrasive medium in the cleaning nozzle and the method is applicable to iron, steel and non-ferrous castings.

14-12. **The Gating and Feeding of Steel Castings.** S. T. Jazwinski, E. D. Wells and S. L. Finch. *Foundry Trade Journal,* v. 77, Dec. 13, '45, pp. 323-326.

Discussion on paper which appeared in earlier issues.

14-13. **Chills for Light Alloys Castings.** A. E. Cartwright. *Aluminum & Magnesium,* v. 2, Dec. '45, pp. 23-24, 38.

Special reference to the use of aluminum as a chill material.

14-14. Magnesium Foundry. *Aluminum & Magnesium,* v. 2, Dec. '45, pp. 25-29.

Sand conditioning section; fettling shop; heat treatment department; inspection department; X-ray department; mechanical and chemical test laboratories.

14-15. Foundry Practice at Consolidated. T. R. Stanley. *Canadian Metals and Metallurgical Industries,* v. 8, Dec. '45, pp. 24-26.

Production of wide range of castings for maintenance and repair.

14-16. Light Alloy Castings. G. M. Young. *Canadian Metals & Metallurgical Industries,* v. 8, Dec. '45, pp. 27-33.

Prospects and problems in extended use and foundry facilities. Outstanding property characteristics of the light metals; aluminum alloy development; aluminum casting alloys; oxide coatings on aluminum; casting methods; testing of structural castings; magnesium alloys; foundry problems; X-ray as an inspection and development tool; secondary aluminum for casting alloys; postwar prospects for the light metals.

14-17. Sealing Porous Castings. P. S. Fuller. *Materials & Methods,* v. 22, Dec. '45, pp. 1746-1750.

Micro-porous flaws in castings now sealed by plastic material which is excellent in heat and chemical resistant properties.

14-18. Cast Iron. J. E. Hurst. *Iron & Steel,* v. 18, Dec. '45, pp. 635-640.

The effect of residual or trace elements; service behavior of cast irons; soundness in castings.

14-19. Effect of Thermal Conductivity of Mold Material. Carl Wessel. *Light Metal Age,* v. 3, Dec. '45, pp. 20-21, 32, 45.

Consideration of the application of the fundamental laws of physics to the casting of metals, with particular reference to thermal conductivity properties of mold materials.

14-20. High-Pressure Feeding of Static Molds. Part I. S. T. Jazwinski and S. L. Finch. *Iron Age,* v. 157, Jan. 10, '46, pp. 59-63.

Process utilizes gas pressure built up in the feeder head and an exothermic reaction to create sufficient heat to compensate conduction and radiation losses. Theory and practice of this new feeding method are outlined.

14-21. Sodium Silicate Sealing of Aluminum Castings. *Iron Age,* v. 157, Jan. 10, '46, p. 63.

Tests indicate that although castings seemed to be completely sealed immediately after treatment, many developed leaks at the end of a four-week period. Important fact observed, however, was that such leakage remained fairly constant thereafter. Attempt made to secure additional protection against leaking by baking some of the castings at 220° for 2 hr. after the sodium silicate treatment. No measurable effect was known to result after baking.

14-22. Centrifugal Casting Aluminum. *Modern Metals,* v. 1, Jan. '46, pp. 14-16.

Process, design characteristics, production equipment and production, metal control. Bibliography, 25 ref.

14-23. **Clean Sweep for Die Casting!** *Die Casting,* v. 4, Jan. '46, pp. 26-28, 30, 32.

Extremely complex shapes are die cast from light weight aluminum alloys—these intricate castings, ultra streamlined on the exterior and ingeniously cored on the interior make possible the creation of an easily assembled, attractive product.

14-24. **High-Pressure Feeding of Static Molds, Part II.** S. T. Jazwinski and S. L. Finch. *Iron Age,* v. 157, Jan. 17, '46, pp. 54-63.

Practical applications of method of utilizing gas pressure to a variety of static molds described. Consistently high yield of castings to metal used and soundness of parts graphically illustrate the superiority of this process to older methods.

14-25. **Gray Iron Acceptance Broadens.** Tom Barlow. *Foundry,* v. 74, Jan. '46, pp. 70-75, 162, 165.

Importance of gray cast iron as versatile and valuable material suitable for new applications is realized more fully by design engineers as a result of wartime experiences. Better operating control and research developments raise product quality. Mechanization of plants is more general.

14-26. **Steel Castings Find New Applications.** C. E. Sims. *Foundry,* v. 74, Jan. '46, pp. 76-81, 222, 224-225.

War needs give steel castings opportunity to prove worth. Water quenching comes to fore.

14-27. **Aluminum Foundries Raise Casting Quality.** L. W. Eastwood. *Foundry,* v. 74, Jan. '46, pp. 82-87, 165-166.

Specialized technique for producing highest quality aluminum castings extended to many smaller foundries. Wartime demands expand industry's capacity seven to eight times that of prewar production. Plant mechanization, improved inspection methods, and some trends in selection of alloys are other important aluminum foundry developments of recent years.

14-28. **Malleable Industry Improves Plant Facilities.** C. H. Lorig. *Foundry,* v. 74, Jan. '46, pp. 92-97, 214-216, 218.

Modernization of malleable foundries, stimulated by war needs, includes more general adoption of continuous melting, mold conveyors, mechanical sand handling equipment and more efficient types of annealing ovens.

14-29. **Brass and Bronze Foundries Make Metallurgical Advances.** A. H. Hesse. *Foundry,* v. 74, Jan. '46, pp. 98-103, 218.

Increased use of manganese bronze and "down grading" of tin bronze were outstanding metallurgical developments of war years. Progress is made in application of centrifugal and precision casting methods, also in cupola melting of brass.

14-30. **A Review of the Major Changes in Gray Iron Foundry Practice During the Period 1914-1944.** A. E. McRae Smith. *Foundry Trade Journal,* v. 77, Dec. 27, '45, p. 371-377.

Concentration of effort by metallurgists and foundrymen required in the future.

14-31. **Quotation for Aluminum Alloy Castings.** E. Carrington. *Light Metals,* v. 9, Jan. '46, p. 43-48.

An analysis of those factors largely peculiar to the light alloy foundry industry, due consideration of which is essential when fulfilling orders for light alloy castings, and a knowledge of which is likely to prove of value to the prospective purchaser of such castings.

14-32. **The Hot-Strength Characteristics of Molding Sands.** W. Davies and W. J. Rees. *Iron and Steel Institute Advance Copy,* Dec. '45, 10 p.

Summary of the differences between the hot-strength characteristics of the various clay bonds in relation to their mineralogical constitution. 2 ref.

14-33. **Sand Supply to Molding Machines From Overhead Hoppers.** N. C. Blythe. *Foundry Trade Journal,* v. 78, Jan. 3, '46, p. 9-11.

Design of hoppers; controlling factor; sand supply to hoppers; working results.

14-34. **Non-Ferrous Castings.** G. Elston. *Foundry Trade Journal,* v. 78, Jan. 3, '46, p. 19-20.

Sand for non-ferrous castings; melting; casting temperatures.

14-35. **Malleable Sand Control.** *American Foundryman,* v. 9, Jan. '46, p. 42-47.

Summary of the answers of some 14 companies to a questionnaire on malleable sand control.

14-36. **Cleanliness and Safety in the Foundry.** James Thomson. *American Foundryman,* v. 9, Jan. '46, p. 48-49.

Foundry cleanliness—its importance in promoting safety and in effecting foundry operating economies. (From *Safety Engineering,* Sept. 1944.)

14-37. **Some Aspects of Green Deformation and Sand Toughness in Sand Control.** William G. Parker. *American Foundryman,* v. 9, Jan. '46, p. 50-54.

Deformation and sand toughness number determinations provide the foundryman with important tools—too seldom used—for molding sand mixing efficiency and workability control—these factors directly affecting the amount of foundry scrap and machining time.

14-38. **Melting Magnesium Alloys.** L. M. Nash. *American Foundryman,* v. 9, Jan. '46, p. 61-62, 79.

Developments in magnesium foundry melting. Wet flux method; crucible method; preventing oxidation; silicon content; stirring the melt; superheating the melt; gas causes porosity.

14-39. **Melting and Casting.** Edwin F. Cone. *Materials and Methods,* v. 23, Jan. '46, p. 110-114.

Openhearth steel; electric steel; foundry practice—iron and steel castings; non-ferrous melting and casting; process types—centrifugal and die casting; precision casting.

14-40. **The Hot-Strength Characteristics of Molding Sands.** W. Davies and W. J. Rees. *Iron and Steel Institute Advance Copy,* Dec. '45, 10 p.

Results of research at Sheffield University. Attention has so far been directed towards the differences between the hot-strength characteristics of the various clay bonds in relation to their mineralogical constitution. 2 ref.

14-41. Precision Casting Practice. *Steel,* v. 118, Jan. 28, '46, p. 116-118, 150, 152, 156.

Fast, simple and low cost method of producing a variety of accurate and dense castings. Complicated parts requiring several different machining operations, or parts that for some reason cannot be machined, are suited to the process. Intricate parts which usually require the services of a skilled craftsman often are duplicated easily by the lost wax technique. A few of the many types of castings that can be produced by this method are shown.

14-42. Safety in the Use of Die Casting Machines. *Western Metals,* v. 4, Jan. '46, p. 59-60.

Methods of prevention applied to problems of safety involved in the installation, operation and maintenance of most types of die casting machines.

14-43. Pressure Casting of Large Aluminum Rotors at Reliance Electric & Engineering Co. Stanford Markey. *Modern Industrial Press,* v. 8, Jan. '46, p. 26-28, 40.

Various steps involved in casting operation, problems overcome and production facilities.

14-44. Fundamentals of Pouring Magnesium Sand Cast Alloys. E. J. Vargo. *Aluminum and Magnesium,* v. 2, Jan. '46, p. 14-17.

Melting and pouring of the mold and some of the problems yet to be solved.

14-45. Precision Casting Practice. *Steel,* v. 118, Feb. 4, '46, p. 128-129, 166, 168, 170.

Factors which may determine success or failure in production operations.

14-46. Employs Simple Rig for Making Blast Furnace Tuyeres. Pat Dwyer. *Steel,* v. 118, Feb. 4, '46, p. 138, 140, 143.

Casting is molded and poured big-end-down, with the entire body in a one-piece cast iron flask that serves for both cope and cheek. Drag is a cast iron plate ribbed on the bottom for strength, drilled on the face for core prints and equipped with a pair of stationary pins for guiding the cope into place. Face is machined to a true plane and carries a single small gate channel from a point near one corner to a point near the print for the center core.

14-47. Magnesium Melting Practice. LeRoy M. Nash. *Iron Age,* v. 157, Feb. 7, '46, p. 61-63.

Current magnesium melting practice, as improved by war-spurred research reviewed with particular reference to the effect of crucible material and scrap condition on the purity of the cast metal.

14-48. Application of Ethyl Silicate to Foundry Practice. Clifford Shaw. *Foundry Trade Journal,* v. 78, Jan. 10, '46, p. 31-33.

Production of silicon esters; alkali addition; condens-

ing agents; foundry properties; molding from wax models; semi-dry piece mold; scope with large castings.

14-49. Notes on Sand Control for Magnesium Castings. D. R. Andrews. *Foundry Trade Journal,* v. 78, Jan. 10, '46, p. 34.

Suitable bonding materials; facing sand; core sand.

14-50. Pattern Making for Small Batch, Machine Molded Castings. A. G. Squires. *Foundry Trade Journal,* v. 78, Jan. 10, '46, p. 35-37.

Plaster patterns; limitations of process; gage for locating patterns; test for accuracy.

14-51. Patterns in the Jobbing Foundry. W. C. Manwell. *American Foundryman,* v. 9, Feb. '46, p. 30-36.

Well-made pattern, designed for practical foundry procedure, enables the foundryman to produce a better casting at lower cost. Jobbing foundries, handling a variety of patterns, find that close cooperation with the pattern maker will solve many production problems, preserving the castings' advantages over competitive processes.

14-52. Necked-Down Riser. Sam Belus. *American Foundryman,* v. 9, Feb. '46, p. 40-41.

Photographs which show rather clearly how a certain troublesome job was simplified in the jobbing foundry.

14-53. Cupola Operation and Control. W. W. Levi. *American Foundryman,* v. 9, Feb. '46, p. 46-54.

Carbon control; recording cupola mixtures; intermittent tapping; by-product coke; pitch coke; mechanical charging; weighing cupola charges; cupola blast moisture control; inoculant type; cupola charge additions.

14-54. Aluminum Casting Stability. *American Foundryman,* v. 9, Feb. '46, p. 65-69.

Report of the A.F.A. committee on dimensional changes in aluminum alloy castings caused by density changes; residual stresses resulting from plastic deformation, selection of conditions and treatments to attain stability.

14-55. The Application of Ethyl Silicate to Foundry Practice. Clifford Shaw. *Foundry Trade Journal,* v. 78, Jan. 17, '46, p. 61-63.

Discussion of article in *Foundry Trade Journal,* Jan. 10.

14-56. The Gassing of Bronzes by Reaction With Molding and Core Sands. W. T. Pell-Wallpole. *Foundry Trade Journal,* v. 78, Jan. 24, '46, p. 87-89.

Sand permeability; examples of gassing from foundry practice; gas absorption in phosphor-bronze billets for extrusion; gassing of chill-cast phosphor bronze poured through molded sand bowls; gassing of cored sticks poured in chill molds with a loam-coated chill core; gassing of bronze due to use of green sand for thickening the flux; factors controlling the gassing reaction. 4 ref.

14-57. Aluminum Alloys Foundries. Joseph Geschelin. *Automotive and Aviation Industries,* v. 94, Feb. 1, '46, p. 28-32.

Comprises competent engineering department capable of advising on matters of product design; modern metallurgical department for the control of materials and alloys

and foundry practice; and unquestioned know-how in the design of pattern equipment and permanent molds and in the details of specialized foundry practice, particularly that of gating and risering.

14-58. **The Origin of Micro-Cavities.** Eugene Mitzsche. *Light Metal Age,* v. 4, Jan. '46, p. 12-13, 31.

Describes some of the lesser-known ways in which hydrogen and other gases which cause cavities and porosity may be picked up in the light metal foundry. Methods for prevention and elimination of these causes for porosity are given. 1 ref.

14-59. **Expansion in Die Casting.** John Parina, Jr. *Steel,* v. 118, Feb. 11, '46, p. 96, 150, 152-153.

Heavy demand for die cast products, resulting in part from economical fabrication, has necessitated expansion of die casting capacity. Largest bottleneck at present facing that industry is shortage of specially trained die makers and designers.

14-60. **Foundry Ventilation.** John M. Kane. *Foundry,* v. 74, Feb. '46, p. 86-89, 228, 230, 232-233.

Ventilation requirements in various phases of foundry operation; discussion of the foundry ventilation problem following operations from the pouring of the molten metal in the flask to the final finishing of the casting in the cleaning room.

14-61. **Mold Cavity Variation.** Robert Cleland. *Foundry,* v. 74, Feb. '46, p. 91, 220, 222.

Tabulation suggests to sand controller the factors to be considered in seeking the cause of shrinks and porosity—insofar as they are caused by the sand—and of dimensional inaccuracy.

14-62. **Motion Radiography of Mold Pouring.** S. A. Fry. *Foundry,* v. 74, Feb. '46, p. 92-96, 163-166.

Combination of motion picture camera, fluorescent screen and X-ray permits recording and subsequent study of what occurs when molten metal is poured into a mold. (Paper for Institute of British Foundrymen.)

14-63. **The Age of Green and Dry Sand Molding.** J. E. Hurst. *Foundry,* v. 74, Feb. '46, p. 97, 208, 210.

History of green and dry sand molding.

14-64. **Non-Ferrous Foundry Research at the Naval Research Laboratory.** Blake M. Loring. *Foundry,* v. 74, Feb. '46, p. 98-101, 247-249.

How the Navy handles metallurgical problems relating to non-ferrous castings.

14-65. **Shakeout Handles Large Castings.** James L. Yates. *Foundry,* v. 74, Feb. '46, p. 102-103, 166.

"World's largest" foundry shakeout, designed to handle flasks weighing up to 75 tons (sand, casting and flask) and with a vibrating shakeout deck 396 sq. ft. in area. Coupled with the shakeout is a complete sand collecting, distribution and storage system which collects sand from the shakeout, removes fines, separates out tramp metal and transports it either into the foundry for conditioning or places it in storage. All dust incidental to shakeout or

transportation of the sand is under control and the collected dust is discharged as wet mud.

14-66. Foundry Uses Cupola and Direct Metal. Pat Dwyer. *Foundry,* v. 74, Feb. '46, p. 104-107, 234, 236.

Describes Bethlehem Steel Co.'s iron foundry practice for heavy castings.

14-67. Weather Affects Chill Depths. Eric Wisbrun. *Foundry,* v. 74, Feb. '46, p. 108-109, 174, 176.

Excessive chilling effect in very sensitive chill wedges for melting and cupola control; depth of chill in the wedge increased gradually and became alarming; fluidity spiral and analysis bar did not show corresponding changes though poured from the same ladle in the same mold.

14-68. Using Synthetic Resin Core Binders. H. L. Gebhardt. *Foundry,* v. 74, Feb. '46, p. 110-112, 198, 200, 202, 204, 206.

Synthetic core binders are heat reactive; will "set up" or "cure" with oven heat, but do not require oxygen in baking to develop a bond between sand grains. Low oven temperature will do, and just enough time to dry the core thoroughly will be sufficient to set the bond. Heat is the curing agent and is effective at ranges so low that 250° F. can complete the action. Heat applied with infra-red lamps can be as effective as oven heat.

14-69. Gravity Die Casting From the Engineer's Viewpoint. M. R. Hinchcliffe. *Engineering,* v. 161, Jan. 11, '46, p. 45-48.

The permanent molds or dies employed in the gravity die-casting process are machined from cast iron or steel sections suitably doweled and clamped together in the correct sequence for opening and closing, the external shape of the casting being formed by sectional blocks which slide to and fro on a suitable base plate, while the inside of the casting is formed by cores which are extracted from the solidified casting by means of pinch bars.

14-70. Weight Estimation for Die Casting. H. K. Barton and L. C. Barton. *Machinery,* v. 68, Jan. 31, '46, p. 159-161.

Bead; fillet; circular ribs and grooves; hollow radial bends.

14-71. Steel Spar Casting. *Aircraft Production,* v. 8, Feb. '46, p. 85-94.

Design and manufacture of highly stressed member of fuselage.

14-72. New Castings for Old in Aluminum. *Light Metals,* v. 9, Feb. '46, p. 73-77.

Background of the aluminum foundry industry. Shows manufacturers of metal goods what they may expect in the way of good quality castings; advice as to the use of aluminum alloys.

14-73. The Gassing of Bronze by Reaction With Molding and Core Sands. W. T. Pell-Walpole. *Foundry Trade Journal,* v. 78, Jan. 31, '46, p. 105-108.

Experimental method; general effects of gassing on the properties of bronze; density and tensile properties.

14-74. Permanent Mold Aluminum Castings Made by Highly Perfected Technique. Hiram Brown. *Steel,* v. 118, March 4, '46, p. 125-126.

In the permanent metal mold process, castings are precision made to tolerances as close as plus or minus 0.010 in. This compares with the standard of plus or minus 0.030 in. for sand casting. Smooth surfaces and fine grain structures are added advantages. Output from machining lines is high because of the uniform dimensions of the permanent mold castings. For example, master brake pistons are easily machined at rate of 1000 per hr. on a standard six-spindle Acme Gridley automatic.

14-75. **Mechanized Brass Foundry.** Thomas Lyons. *Canadian Metals and Metallurgical Industries,* v. 9, Feb. '46, p. 29-31.

Output increased 80% by program of mechanization.

14-76. **Inspection in a Mechanized Foundry.** T. Cook. *Foundry Trade Journal,* v. 78, Feb. 7, '46, p. 133-145.

Erection of jigs and gages; core scraping jigs; dimensional checking; crankcase castings; jig spotting; camber elimination; pressure testing; section thickness; manifold castings; engine set inspection; three spot jigging; larger location. (Paper read before the Scottish branch of the Institute of British Foundrymen.)

14-77. **The Gassing of Bronzes by Reaction With Molding and Core Sands.** W. T. Pell-Walpole. *Foundry Trade Journal,* v. 78, Feb. 7, '46, p. 147-150.

Gassing action of sands without artificial bonding; gassing action of bonding agents without sand; gassing action of sands with additions or artificial bonding agents.

14-78. **The Gassing of Bronzes by Reaction With Molding and Core Sands.** W. T. Pell-Walpole. *Foundry Trade Journal,* v. 78, Feb. 14, '46, p. 163-167.

Effect of variation in concentration of the bonding agent; effect of the total quantity of bonded sand in contact with the molten bronze; effect of sand baking conditions.

14-79. **Some Notes on High Duty Cast Iron.** A. H. Horton. *Foundry Trade Journal,* v. 78, Feb. 14, '46, p. 169-171.

Production of high duty cast iron; cupola practice; types of high duty cast iron; alloys added to increase strength; the heat treatment of high duty cast irons; soft gray iron castings. 6 ref.

14-80. **British Resources of Steel Molding Sands. Parts 6 to 10.** W. Davies and W. J. Rees. *Iron and Steel Institute Advance Copy,* Jan. '46, 46 p.

The sand deposits associated with the Lincolnshire wolds; the quartzitic grits and sandstones of Nidderdale and Wharfedale; the quartzitic sandstones in the Cefn-y Fedw series of North Wales; the rotten-rock molding sands of Durham and South Northumberland; the rotten-rock molding sands of the Midland Valley of Scotland.

14-81. **The Formation of Banded Structures in Horizontal Centrifugal Castings.** C. Howson. *Foundry Trade Journal,* v. 78, Feb. 21, '46, p. 191-199.

Notes on the examination of carefully selected examples typical of a wide range of alloys; flow of metals in a rotating tube; tangential force; resultant force acting on a

unit particle in the melt; variation of the value of the resultant during rotation; conditions of "forced vortex"; description of the structures encountered in centrifugal castings; non-columnar zone; minimum time; bore zone. 4 ref.

14-82. **Pressure Die Casting.** G. T. Vicary. *Foundry Trade Journal,* v. 78, Feb. 21, '46, p. 201-204.

Zinc alloy die castings; early history; metal die; die costs; surface of die castings; cost of die castings; requirements of pressure die-casting alloy. (Paper read before Institute of British Foundrymen.)

14-83. **The Gassing of Bronzes by Reaction With Molding and Core Sands.** W. T. Pell-Walpole. *Foundry Trade Journal,* v. 78, Feb. 21, '46, p. 209-210.

Effect of pouring conditions. 1 ref.

14-84. **Recent Developments in Magnesium Foundry Melts.** L. W. Eastwood, James A. Davis and James C. DeHaven. *Light Metal Age,* v. 4, Feb. '46, p. 8-11, 17, 22-23, 25.

Classical method of melting; new methods of metal preparation and metal handling; chlorine fluxing; grain refinement; chlorine-carbon tetrachloride mixture; carbon-inoculated ingot; effect of temperature; effect of various melt treatments; super-heating; commercial applications; grain-refining constituent; handling foundry melts; pumping, design of pumping system; general considerations. 8 ref.

14-85. **Impregnating Magnesium Castings.** Samuel A. Moore. *Iron Age,* v. 157, March 14, '46, p. 76-80.

Behavior of various types of impregnating agents, with particular reference to the relationship of baking time and pressure to the efficacy of the sealing action. Considerable data also given on a resin-styrene compound which is non-thermoplastic and does not require an explosive chemical catalyst.

14-86. **Aluminum Castings.** *Automobile Engineer,* v. 35, Feb. '46, p. 54.

Design points which will avoid foundry difficulties. Solidification; stress concentrations; size limitation.

14-87. **Postwar Operations of Aluminum Foundries.** W. H. Gunselman. *Aluminum and the Non-Ferrous Review,* v. 10, Oct.-Dec., '45, p. 70, 72, 74.

Commercial possibilities; value of test reports; rigid specifications; foundry operations control; furnace charge quality; casting inspection; castings reclamation; personnel control; cooperation necessary; laboratory facilities; maintenance organization. (Abstracted from *American Foundryman.*)

14-88. **Casting Molds for Small Billets.** Pat Dwyer. *Steel,* v. 118, March 18, '46, p. 126-128.

Method of making small ingot molds to be used in the production of steel ingots 3½ in. square and 24 to 42 in. long.

14-89. **Duplex Pump Castings.** R. H. Brown. *Foundry Trade Journal,* v. 78, Feb. 28, '46, p. 223-233.

Layout and plant; sand plant; melting equipment; mold

washes; laboratory and shop tests; types of castings produced; steam cylinders; air exit off ports; complicated core assembly; gun metal valve plates; bronze cylinder castings; light pump castings; valve box castings.

14-90. **The Gassing of Bronzes by Reaction With Molding and Core Sands.** W. T. Pell-Walpole. *Foundry Trade Journal,* v. 78, Feb. 28, '46, p. 235-238, 240.

Effect of composition of bronze on its sensitivity to gassing by reaction with sand; effect of phosphorus, tin, zinc, lead; effect of small additions of some elements which may be present as impurities in bronzes; general conclusions; recommendations.

14-91. **Converter Process in Steel Foundries.** John Howe Hall. *Foundry,* v. 74, March '46, p. 82-83, 221-224.

Use of the converter in making steel for castings; general procedure in operating the unit and the influence of silicon oxidation in raising the molten metal to a high temperature during the blow. 2 ref.

14-92. **Preventing Gray Iron Surface Roughness.** Edward V. Somers. *Foundry,* v. 74, March '46, p. 84-87, 171.

Effect of ferrostatic pressure on metal penetration of the mold sand causing surface roughness. Other methods to reduce penetration are harder ramming, baking the mold, blacking and skin drying the mold surface, but these methods are also dependent on ferrostatic pressure that exists when the mold is poured.

14-93. **Gases in Bronze.** Robert A. Colton. *Foundry,* v. 74, March '46, p. 88-89, 134, 136, 141.

Discusses and summarizes studies made in the past on gas solubility in metals and gas or gases responsible for porosity. 58 ref.

14-94. **Increases Malleable Iron Capacity.** Pat Dwyer. *Foundry,* v. 74, March '46, p. 90-93, 214, 216, 218, 220.

Albion Malleable Iron Co. revamped and re-equipped the existing plant, introduced new method of operation, and increased the working force to a number sufficient to operate the plant day and night.

14-95. **Core Blowing Practice.** Lawrence D. Pridmore. *Foundry,* v. 74, March '46, p. 94, 168, 171.

Proper venting technique probably is the most important factor in core blowing practice. Proper sand mixture also is important. Ordinary line pressure in any foundry —from 70 to 90 psi.—can be employed to blow cores provided the sand characteristics are suitable.

14-96. **Making Cored Aluminum Castings.** *Foundry,* v. 74, March '46, p. 97-98, 226-227.

Labor-saving equipment and devices necessitated by high percentage of women employed to make cores on the bench, machine and on blowers, to finish the cores, inspect, assemble, and again inspect them. Core sand was mixed by women and they also checked the melting and pouring temperatures of the various types of the aluminum alloys.

14-97. **Putting Equipment to Work.** R. G. McElwee. *Foundry,* v. 74, March '46, p. 99, 132.

Improvement can be shown by maintaining constant

control of cupola practice by means of control equipment and laboratory apparatus.

14-98. **Foundry Ventilation. Part 2.** John M. Kane. *Foundry,* v. 74, March '46, p. 104-108, 144, 146, 150.

Ventilation requirements of sand systems, molding floor and cleaning room. 8 ref.

14-99. **Melting Methods Affect Quality of Die-Cast Aluminum. Part I.** Davidlee Von Ludwig. *Industrial Gas,* v. 24, March '46, p. 9-13, 32-33.

Series of tests to determine how great effect of porosity was upon the actual serviceability of the part; results given in table.

14-100. **Precision Investment Castings.** Edwin Laird Cady. *Materials and Methods,* v. 23, March '46, p. 741-760.

General description; design factors; metals and alloys; plant practice; patterns and molding.

14-101. **New Magnesium Die-Casting Alloy.** R. F. Hauser. *Modern Metals,* v. 2, March '46, p. 8-10.

New die-casting alloy with less hot cracking tendency is known as Eclipsaloy 130 alloy and meets the demand for complex die-cast designs including both heavy and light sections. Chemical composition, mechanical properties, microstructure, corrosion resistance, casting characteristics, cleaning of castings.

14-102. **Permanent Mold Fundamentals.** J. W. Wheeler. *Modern Metals,* v. 2, March '46, p. 11-16.

Early progress of the aluminum permanent-molding process. Mold life; design limitations and the economic advantages of this process over sand and die casting. Method of tool and mold manufacture; selection and training of labor. Reasons for metal losses; some future possibilities of larger light-metal permanent-mold castings.

14-103. **Precision Refractory Molding Method.** *Modern Metals,* v. 2, March '46, p. 19-20.

Precision casting by the refractory molding method is a refinement of the sand foundry method. Accurate control of factors involved in guiding liquid metal into place is made practical by the development of the large volume of treated water to calcined gypsum and magnesium silicate as a molding investment. Engineering characteristics of the process; design considerations; general manufacturing problems; application data.

14-104. **Continuous Casting Process.** *Steel,* v. 118, April 1, '46, p. 140.

Bronze rod and tubing are being produced commercially in 10-ft. lengths by continuous withdrawal of molten metal from overhead crucible through chilled die.

14-105. **A Foundryman's Notebook—IV.** *Iron and Steel,* v. 19, March '46, p. 110.

Molding technique for high-duty cast iron.

14-106. **Aluminum-Bronze Permanent-Mold Castings.** B. Johnson. *Iron Age,* v. 157, April 4, '46, p. 80-83.

Casting the 86% Cu, 10% Al alloy in gravity-filled die

molds to produce castings with superior hardness, grain and surface characteristics and to closer size tolerances. Details of mold construction and operation.

14-107. **The Feeding of Castings.** R. W. Ruddle. *Foundry Trade Journal,* v. 78, March 7, '46, p. 253-257.

Why castings require feeding; elementary consideration of the fundamentals underlying the satisfactory feeding of castings and the physicochemical properties of metals when they solidify. (Paper presented to the Institute of Australian Foundrymen.)

14-108. **Molding Large Meehanite Crankshafts.** George Johnstone. *Foundry Trade Journal,* v. 78, March 7, '46, p. 261-264.

Advantages and disadvantages of three methods: *(a)* vertical pouring and cooling; *(b)* horizontal pouring and vertical cooling, and *(c)* horizontal pouring and horizontal cooling.

14-109. **Pattern Analysis for Buyers of Patterns and Castings.** Vincent J. Sedlon. *American Foundryman,* v. 9, March '46, p. 24-26.

Guide for purchasers of patterns and castings, to assist them in the selection of equipment comparable to the number and quality of castings required.

14-110. **Core Ovens.** H. E. Linsley. *American Foundryman,* v. 9, March '46, p. 27-31.

Equipment and processing methods for cylinder head molds and cores and magnesium casting cores; construction and operation of baking and drying ovens; mechanical materials handling installations. Magnesium core-sand mixtures identified by color system. Care and storage of cores in air-conditioned storage rooms. Operation of sand reclamation system.

14-111. **Atmospheric and Washburn Risers.** W. E. Jones. *American Foundryman,* v. 9, March '46, p. 35-38.

Steel foundry riser practice; proper selection and use of risers results in sound castings and effects operating economies particularly in the casting cleaning room.

14-112. **Eliminating Castings Defects.** Pierce Boutin. *American Foundryman,* v. 9, March '46, p. 42-44.

Tracing causes of casting defects; corrective and preventive measures promptly set up; metal flow; gas pressure.

14-113. **Insulating Pads and Riser Sleeves for Bronze Castings.** H. F. Taylor and W. C. Wick. *American Foundryman,* v. 9, March '46, p. 48-68.

Insulating pads and riser sleeves placed respectively on their sections and around risers keep the metal hot and molten until the casting has become solid. Applications of the method show the importance of controlled directional solidification.

14-114. **Hot-Strength Characteristics of Molding Sands.** W. Davies and W. J. Rees. *Engineering,* v. 161, Feb. 22, '46, p. 190-192.

The montmorillonite and secondary mica clays, having

similar atomic structures, attain their peak hot strengths at 900 to 1000° C.; above 1100° C. their hot strength is quite low. The kaolinite clays, on the other hand, attain their peak hot strength at temperatures above 1150° C. These differences are in accord with foundry practice.

14-115. **Some Initial Results on the Influence of Tellurium as a Chill-Inducing Medium in Cast Iron.** *Foundry Trade Journal,* v. 78, March 14, '46, p. 283-287.

By protected additions direct to metal it is possible to obtain any depth of chill close to that desired. Rigid control of percentage added, the means of encasing it, the temperature of the metal used, and to a lesser degree its fluidity, and sectional thickness are important factors.

14-116. **Shortcuts in Motor Production.** *Die Casting,* v. 4, April '46, p. 23, 53-55.

With utilization of interchangeable slides, wide variety of end plate designs are produced in same dies, thus reducing the total tooling investment.

14-117. **Pressure Die Castings in Aluminum Alloys.** E. Carrington. *Light Metals,* v. 9, March '46, p. 152-162.

Current types of pressure die-casting plants, their advantages and limitations and the special qualities of the work produced by these machines.

14-118. **Making Cast Iron Ingot Molds.** Pat Dwyer. *Foundry,* v. 74, April '46, p. 84-86, 240-241.

Practice in Bethlehem Steel Co.'s foundry designed especially for the production of ingot molds. Special large ingot molds in weight up to 55 tons are molded in pits in the floor according to regular jobbing shop technique. Other molds in wide variety of shape, size and weight are molded in cast-iron flasks with cast-iron core barrels covered with an inch or two of sand to form the inside.

14-119. **Cores for Sale.** Erle F. Ross. *Foundry,* v. 74, April '46, p. 87, 198-200.

Company makes up to 10,000 cores a day in sizes ranging from pin cores to complicated ones weighing 100 lb. Does business within a 200-mile radius with foundries having no coremaking facilities or needing to supplement their own output.

14-120. **Modernization of Foundries.** Lester B. Knight. *Foundry,* v. 74, April '46, p. 88-89, 220-222.

Steps necessary to accomplish the modernization of a foundry. Organization; procedures and methods; costs; facilities discussed separately.

14-121. **Ventilating the Mold Shakeout.** C. C. Hermann. *Foundry,* v. 74, April '46, p. 104-105, 210, 212, 214-215.

Fully mechanized foundry provides best possible basis for adequate dust control. Shows a plant where mold shakeout is fully housed with dust piping designed to remove the contaminated air to a dust separator or collector located outside of the building. Other ventilated points include pouring position to remove the gas produced, the point where the mold is separated, the various sand transfer points and the cleaning and storage of the sand.

14-122. **Gray Iron Progress Through Research.** Howard F. Taylor. *Foundry,* v. 74, April '46, p. 106, 227-231.

Consumer public demands improvements; iron has been neglected; prepare to meet challenge; must not ignore research; scientific research program; develop stress-relieving system; should study natural sand. (Paper presented before the annual convention of the Gray Iron Founders' Society.)

14-123. **Converter Process in Steel Foundries. Part II.** John Howe Hall. *Foundry,* v. 74, April '46, p. 107, 160, 162, 164.

Early developments in design of converter units; general practice in converter use.

14-124. **Rapid Test for Fluidity Measurement.** G. B. Taylor. *Iron Age,* v. 157, April 11, '46, p. 62-63.

Modification of the standard fluidity test is designed to simplify making of the spiral mold and to eliminate undesirable time lag in obtaining a reading.

14-125. **Some Pattern Shop Methods and Their Advantages to the Foundry.** H. W. Turner. *Foundry Trade Journal,* v. 78, March 21, '46, p. 315-320.

Principal aim of pattern shop; sharp corners; bosses and core prints; contraction; metal pattern equipment; rapping plates; air-cooled cylinder heads: "layouts"; mold sagging problems; rocker box forms.

14-126. **Centrifugal Casting Applied to Aluminum Alloys.** E. J. Basch, P. Blackwood and J. Perkins. *Foundry Trade Journal,* v. 78, March 21, '46, p. 323-325.

Engineering characteristics of the finished product; design characteristics; sprays; equipment; flushing; production; metal control.

14-127. **Lost-Wax Process Precision-Casts Superalloys.** *American Machinist,* v. 90, April 11, '46, p. 110-113.

Pictorial description of steps in mass-producing parts of stainless, chromium steel, stellite and Hastelloy at the Kokomo plant of Haynes Stellite Division. Tolerances can be held to 0.003 in., weights from 0.002 to 5 lb. (by pressure casting), sizes to 8 in. each way, edges as thin as 0.010 in. Typical parts and production steps are pictured.

14-128. **The German Steel Casting Industry.** Charles W. Briggs. *Steel,* v. 118, April 15, '46, p. 94-96, 118, 120.

Many items normally produced as drop forgings, press forgings or weldments during emergency were cast in gray iron foundries converted to production of steel castings. Study of industry indicates very few improvements or innovations, and quality below United States standards.

14-129. **50 Years of Progress in Cast Metals.** John W. Bolton. *American Foundryman,* v. 9, April '46, p. 98-102.

Traces the development of specifications and their effect on quality control, and points out the relationship between A.F.A. and A.S.T.M. in the making of product standards.

14-130. **Aluminum Alloy Die Casting.** *American Foundryman,* v. 9, April '46, p. 103-111.

Fundamental information on die casting of specific interest to producer and consumer. Die-casting dies and machines; alloys with proper characteristics for die casting; designing; trimming; inspection; finishes.

14-131. **Malleable Iron Foundry Core Practice.** Eric Welander. *American Foundryman,* v. 9, April '46, p. 112-114.

Close control of the core-making process—raw materials, mixtures, core baking and finishing—aid the foundryman to meet increasingly rigid castings specifications.

14-132. **Gray Iron Foundry Sands.** *American Foundryman,* v. 9, April '46, p. 143-147.

Subcommittee on Physical Properties of Gray Iron Foundry Sands at Elevated Temperatures, Foundry Sand Research Project of A.F.A., adopted procedure of first devising pattern and testing equipment, followed by actual foundry work. Laboratory research work under way should yield test methods of practical value.

14-133. **Microporosity in Magnesium Alloy Castings.** L. W. Eastwood and J. A. Davis. *American Foundryman,* v. 9, April '46, p. 148-155.

Interrelation of various major factors determining amount of microporosity in magnesium alloy castings. Program sponsored by Office of Production Research and development of W.P.B.

14-134. **50 Years of Progress in Foundry Sand Control.** R. F. Harrington. *American Foundryman,* v. 9, April '46, p. 158-160.

Chronological report of a half century of development in the field of sand control.

14-135. **Sand Control in a Bronze Foundry.** Clinton J. Converse. *American Foundryman,* v. 9, April '46, p. 164-165.

Moisture—early test; casting defects remedied; grain size; moisture controlled.

14-136. **Aluminum and Light Alloy Founding.** E. W. Fell. *Foundry Trade Journal,* v. 78, March 28, '46, p. 335-339.

Comparison with iron; aluminum melting practice; aluminum casting procedure; molding sands and their properties; testing and inspection procedure for aluminum and magnesium castings; defects to be avoided; founding of magnesium and its alloys; casting temperature; effect of humidity; cold chamber die castings; thermocouple protection; crack detection.

14-137. **A New Feeding Technique for Castings.** T. E. Lloyd. *Iron Age,* v. 157, April 25, '46, p. 62-64.

Use of an exothermically reacting compound in feed gates in ferrous and nonferrous castings provides better metal feeding into the mold. Mixing of the compound, its use as core and facing material, and typical applications in roll and bearing casting.

14-138. **Mass Production of Precision Castings.** *Materials & Methods,* v 23, April '46, p. 1016-1020.

Pictorial story of methods used by Haynes Stellite Co. to achieve amazing output.

14-139. Specification, Design and Production of Iron Castings for Vitreous Enameling. John W. Gardom. *Foundry Trade Journal,* v. 78, April 4, '46, p. 371-375.

Design of castings; specification of castings; annealing; soundness; composition of castings for enameling; carbon; silicon; phosphorus; sulphur and manganese; influence of silicon and phosphorus on carbon content; other effects of silicon and phosphorus; influence of phosphorus.

14-140. Gravity Casting for Mass Production. E. Carrington. *Light Metals,* v. 9, April '46, p. 169-179.

Comprehensive discussion on the theory, practice, and economics of permanent-mold casting. Value of the technique as an aid to reconstruction.

14-141. Centrifugally Cast Steel. L. Northcott and D. McLean. *Steel,* v. 118, April 29, '46, p. 94-98, 100, 102, 104.

Studies of structure and properties of thick, nickel-chromium-molybdenum steel cylinders cast in chill molds without a central core indicate best castings are obtained with vibration-free mold speeds, high casting temperature and slow pouring.

14-142. How Chemicals Aid in Revolutionary Precision Casting Process. *Chemical Industries,* v. 58, April '46, p. 602-604.

The "lost-wax" process; use being made of waxes and ethyl silicate. Profusely illustrated.

14-143. Precision Casting Methods and Equipment. Joseph Geschelin. *Automotive and Aviation Industries,* v. 94, April 15, 1946, p. 20-23, 108.

Precision castings made by Haynes Stellite Co.; methods and equipment.

14-144. Precision Casting on a Mass-Production Basis. Charles O. Herb. *Machinery,* v. 52, May '46, p. 149-158.

Precision casting operations in new plant of Haynes Stellite Co. Advantages of process. One part that formerly required 42 separate machine-shop operations, a heat treatment, and four grinding operations is now produced with all dimensions cast to size within a few thousandths of an inch, and requires only four grinding operations.

14-145. Chill-Cast Bronzes. W. T. Pell-Walpole. *Metal Industry,* v. 68, April 19, '46, p. 303-305.

Various types of porosity commonly encountered in foundry. Cause, nature, and appearance of entrapped gas, shrinkage and soluble gas porosity.

14-146. Plaster Composition Match Plates. C. C. Brisbois. *Canadian Metals & Metallurgical Industries,* v. 9, April '46, p. 22-26.

Improved methods of production at Robert Mitchell Co., Limited. New-type one-piece frame developed.

14-147. The "Lost-Wax" Process of Precision Casting. W. O. Sweeny. *Modern Machine Shop,* v. 18, May '46, p. 138, 140, 142, 144, 146, 148, 150, 152, 154, 158, 160, 162, 164, 168.

Outline of the Haynes Stellite method of procedure.

14-148. Producing 70 Tons of Die Castings Daily. Herbert Chase. *Iron Age,* v. 157, May 9, '46, p. 76-80.

Equipment and procedures used in achieving the unusually high production of 70 tons daily in the world's largest single plant for die casting. Extensive mechanization of the casting handling system.

14-149. **How Haynes Stellite Makes High Precision Castings.** *Machine Tool Blue Book,* v. 42, May '46, p. 165-173.

Castings reproduce every complicated curve and angle of master pattern, and require little or no subsequent machining or grinding. Materials of which they are cast include Haynes Stellite cobalt-base alloys, Hastelloy nickel-base alloy, Hascrome iron-base composition and other Haynes high-temperature alloys and stainless steels.

14-150. **German Steel Foundry Methods.** *British Steelmaker,* v. 12, April 13, '46, p. 176-179.

Plants visited; steel melting; molding practice; centrifugal castings; cast armor; inspection.

14-151. **Aluminum Casting Processes and Applications.** Hiram Brown. *Modern Metals,* v. 2, May '46, p. 9-12.

Various aluminum casting techniques and physical limitations and applications for each process. Sand, permanent mold, die, plaster, and centrifugal casting methods; new alloy developments and typical applications.

14-152. **Economics in Magnesium Foundry Practice. Part 1.** C. H. Mahoney and Pierre E. Le Grand. *Modern Metals,* v. 2, May '46, p. 14-19.

Grain refinement in the aluminum-containing alloys; grain size habits of nonsuperheated metals; superheating effects; grain size fixing by inoculation; production history of inoculation; superheating eliminated. 13 ref.

14-153. **How to Resin Seal Porous Metal Castings.** Prescott C. Fuller. *Plastics,* v. 4, May '46, p. 58-62.

Process makes castings pressure tight, saves material, time, money. Use of Polyplastex MC as an impregnant.

14-154. **Mass Production of Precision Castings.** William G. Gude. *Foundry,* v. 74, May '46, p. 164-169, 232.

Outstanding accomplishment in wartime production of precision castings was adaptation of mass-production methods to a process which previously had been employed for tailor-made products.

14-155. **Blowing Cylinder Barrel Cores.** Arthur H. Allen. *Foundry,* v. 74, May '46, p. 170-173, 288.

Man-hour output in producing 65-lb. cylinder barrel cores has been more than tripled by Buick Motor Division by use of automatic blowing and handling equipment.

14-156. **Converter Process in Steel Foundries.** John Howe Hall. *Foundry,* v, 74, May '46, p. 174, 316, 317, 318, 319.

Operating conditions with different types of converters.

14-157. **Cupola Operation—a Review of Logical Cupola Practice.** D. H. Young. *Foundry Trade Journal,* v. 78, April 25, '46, p. 429-432, 439.

The principal concern in cupola practice is the most efficient burning of a body of fuel. It is essential to have on tap a constant supply of metal with the required superheat for foundry needs, and to do so with the minimum

consumption of fuel. Air requirements; tuyere areas; coke quality; melting zone and depth of bed; metal-to-coke ratio; slagging. (Paper for Scottish Branch of Institute of British Foundrymen.)

14-158. **Chill-Cast Bronzes.** W. T. Pell-Walpole. *Metal Industry,* v. 68, May 3, '46, p. 346-348.

Shrinkage porosity, which has the most severely detrimental effects on tensile properties, and entrapped-gas porosity, which has the least harmful effects, are examined. Results of tests are presented in graphical form.

14-159. **Technical Control in a Magnesium Foundry.** G. B. Partridge. *Foundry Trade Journal,* v. 79, May 2, '46, p. 5-8.

Melting technique and sand control are the essentials for scrap minimization.

14-160. **Rapid Baking of Foundry Cores by Dielectric Heating.** Roy T. Wise and James P. Moran. *Materials & Methods,* v. 23, May '46, p. 1307-1312.

Electronic heating of cores, using thermosetting binders, bakes them at such rapid speeds that core baking can be done at production-line rates.

14-161. **Silumin Foundry of Verein Deutsche Metallwerke A. G.** *Foundry Trade Journal,* v. 79, May 9, '46, p. 37-38.

Melting procedure; sand handling and mixing; gravity die casting; magnesium foundry; sand blasting.

14-162. **Steel Molding Sands. A Survey of British Resources —Parts VI to X.** W. Davies and W. J. Rees. *Iron and Steel,* v. 19, May 10, '46, p. 276-285, 308.

Sand deposits associated with the Lincolnshire Wolds; quartzitic grits and sandstones of Nidderdale and Wharfedale; quartzitic sandstones in the Cefn-y-Fedw series of North Wales; rotten-rock molding sands of Durham and South Northumberland; rotten-rock molding sands of the Midland Valley of Scotland.

14-163. **Malleable Core-Making Practice.** E. C. Zirzow. *American Foundryman,* v. 9, May '46, p. 35-42.

Control of core sand mixtures and cores. Due to the number of variables in the making and processing of cores, the sand technician must be constantly on the alert. Simple ways of checking some of these variables are available. Importance of the gas content test has been stressed, not only from the standpoint of producing solid castings, but as a check on core room practice.

14-164. **Centrifugal Casting of a Magnesium Part.** F. P. Strieter and R. J. Maenner. *American Foundryman,* v. 9, May '46, p. 43-47.

Investigation has shown that a commercial magnesium casting can be made successfully by the true centrifugal permanent mold process, the product being equal to or better in quality and efficiency than that obtained in static permanent mold casting. (Paper for American Foundrymen's Association.)

14-165. **Pressure Feeding Iron Castings.** W. J. Bradley. *American Foundryman,* v. 9, May '46, p. 51-54.

Advantages of the pressure-fed type of riser as com-

pared to the old type may be summed up as follows: Castings can be fed more evenly; casting yield is higher —50% greater for gear blanks; manpower is saved by reduction in cleaning and chipping; grinding in the cleaning room is approximately 30% less than required for the old method; all hand feeding is eliminated.

14-166. **50 Years of Progress in Foundry Steel Melting.** A. W. Gregg. *American Foundryman,* v. 9, May '46, p. 58-68.

Survey concerned primarily with the development of steel melting methods and equipment as applied to the steel casting industry. Some historical data pertaining to the earliest methods of making steel included because of their importance and connection with the history of steel foundry melting equipment.

14-167. **Magnesium Foundry Practice.** L. M. Nash. *Metal Industry,* v. 68, May 17, '46, p. 393-394.

Three principal methods of melting magnesium alloys are reviewed and compared. Emphasis is laid on the extreme importance of avoiding all traces of sand and moisture in scrap, ingot, tools and flux. All steps in the process must be rigidly controlled if consistent results are to be obtained.

14-168. **Mass Production of Tank Wheels in Black-Heart Malleable.** A. B. Bill and J. Peers. *Foundry Trade Journal,* v. 79, May 23, '46, p. 75-81.

Layout and operation of a plant specifically laid out to produce large quantities of a particular casting in high-grade black-heart malleable iron; some of the problems which arose; how these were tackled and overcome.

14-169. **Dimensional Stability of Aluminum Alloy Die Castings.** *Die Casting,* v. 4, June '46, p. 19-20, 40.

Report of Casting Stability Committee, Aluminum-Magnesium Division, American Foundrymen's Association. Dimensional stability is of particular importance to manufacturers of precision equipment, gages, instruments or aircraft accessories, where accuracy must be maintained over a wide range of temperature.

14-170. **How Inserts Can Be Used in Die Castings.** *Die Casting,* v. 4, June '46, p. 28-30, 42-46.

Inserting inserts; size of inserts; insert uniformity; insert duties—wear and strength, corrosion resistance, saving assembly time; insert types—fasteners, bushings and sleeves, pins, threaded studs, cast-in tubes.

14-171. **Is the Pattern Shop an Asset or a Liability?** H. Padley. *Foundry Trade Journal,* v. 79, May 23, '46, p. 83-87, 92.

Supports the necessity for a well-equipped, efficiently, and economically run pattern shop.

14-172. **Developments in Gray Iron and Malleable.** G. Vennerholm. *Metal Progress,* v. 49, June '46, p. 1163-1168.

Reviews some of the progress made in gray iron and malleable industry, directly or indirectly as a result of war effort, and discusses some of the metallurgical and other developments which underlie this progress.

14-173. The Manufacture of Some Thin-Walled Steel Castings, With Notes on the Influence of Pouring Speed. *Iron and Steel Institute Advance Copy,* June 30, '46, 16 p.

Least difficulty was met with when the molds were filled quickly, and also less trouble was encountered with hot steel. There was considerable scabbing with very slow casting or with very cool steel. High rates of pouring also reduced the number of rejections due to hot tears, pulls, and other defects such as sand inclusions.

14-174. Continuous Casting of Alloy Bearing Strip. T. W. Lamb and E. C. Jeter. *Materials & Methods,* v. 23, June '46, p. 1567-1570.

Reducing atmosphere, alloy pot, casting pot and cooling jacket are all combined in an ingenious arrangement for steady production of copper-lead bearing alloy.

14-175. Some Casting Troubles. J. L. Francis. *Foundry Trade Journal,* v. 79, May 30, '46, p. 103-111.

Most of the causes of defective castings can be classified under six main headings: wrong alloy composition; unsatisfactory melting technique; unsuitable molding or core sand; incorrect pouring, gating and feeding practice; poor design; and bad workmanship in molds or cores, or errors in assembly. There are also, apart from such faults as damaged molds and cores, short and careless pouring.

14-176. Mass Production of Tank Wheels in "Black-Heart" Malleable. A. B. Bill and J. Peers. *Foundry Trade Journal,* v. 79, May 30, '46, p. 113-116.

Broken molds; maintenance of molding machines; coring of mold; knocking out cast-up boxes; metal melting and distribution; avoiding misruns; offset castings.

14-177. Vacuum Permanent Mold Casting. Jack W. Wheeler. *Foundry,* v. 74, June '46, p. 90-93, 268-270.

Difficulties in casting thin sections by the permanent mold process may be overcome by making use of atmospheric pressure to force molten metal into a cavity from which the air previously had been evacuated. System described originated in France and found successful and widespread application in Europe for cylinder head work during the war.

14-178. Gray Iron Foundry Conditioning. C. W. Schwenn. *Foundry,* v. 74. June '46, p. 104-108, 260.

Conditioning a plant to improve working conditions, production and quality of castings need not be expensive. Details of the cost and savings derived from various improvements made at the foundry of Brillion Iron Works, Inc.

14-179 Mechanized Casting of Soil Pipe and Fittings. Pat Dwyer. *Foundry,* v. 74, June '46, p. 110-112, 246, 248, 250, 257-258.

Operation of the foundry of Warden-King Ltd. in casting a 4-ton high-pressure cylinder for a triple-expansion marine-type engine, in casting soil pipe fittings, boiler sections, radiator castings, and miscellaneous general jobbing castings.

14-180. Foundry Sand Control Plan. Harry W. Dietert. *Foundry,* v. 74, June '46, p. 113.

Both molding and core sands should be prepared to serve a threefold purpose. First, sand should be such that the molders or coremakers can easily ram it and handle the mold or core; second, the sand should be prepared so that it will form as near a perfect container of molten metal as possible; third, molding or core sand should shake out easily. Diagram shows sand preparation for the threefold purpose.

14-181. **Ventilating the Mold Shakeout.** C. C. Hermann. *Foundry,* v. 74, June '46, p. 117, 274, 276, 278.

The down-draft, double canopy hood and totally enclosed shakeout types.

14-182. **Modern Nonferrous Foundry.** *Canadian Metals & Metallurgical Industries,* v. 9, June '46, p. 24-27.

How Sully Brass Ltd. helped increase production by good plant layout, modern lighting and dust control.

14-183. **Sand Casting in Aluminum Alloys.** E. Carrington. *Light Metals,* v. 9, June '46, p. 281-291.

Theory and practice of the use of molding sands; molding systems and methods; representative casting practices.

14-184. **Fettling and Repairing Aluminum Alloy Castings.** E. Carrington. *Light Metals,* v. 9, June '46, p. 325-331.

Preliminary operations essential to all foundry work after actual casting process is completed and prior to despatch of the work.

14-185. **The Hot Tearing Tendencies of Aluminum Casting Alloys.** D. C. G. Lees. *Journal of the Institute of Metals,* v. 72, May '46, p. 343-364.

Two tests have been developed, one in sand molds and the other in copper dies. Most important factors governing resistance to hot tearing are: constitution of the alloy (particularly the proportion of eutectic); grain size; gas content. Tests have been made to determine the stage in freezing at which the alloy shows appreciable strength, and an attempt is made to relate the results of these to the hot tearing behavior. Mechanism of hot tearing is discussed, and method of calculating the eutectic content of complex alloys is suggested.

14-186. **Remelting Practices for Wrought Aluminum Alloys.** Owen Lee Mitchell. *Light Metal Age,* v. 5, June '46, p. 13-15.

Reasons for remelting; types of remelting; batch remelting; semibatch remelting; semicontinuous remelting; conversion charges; typical remelting cycle; charging; melting; skimming; sodiumizing; stirring; fluxing; tapping and syphoning; remelting difficulties; composition control; inclusions; gas; mechanics of degassing.

14-187. **A Note on the Sources of Hydrogen in Cast Iron.** R. C. Tucker. *Foundry Trade Journal,* v. 79, June 6, '46, p. 129-132.

To avoid excessive hydrogen in cast iron, the moisture content of coke should be controlled at 2% maximum.

14-188. **Producing Bomb Castings by Use of the Core Barrel.** Basil Gray. *American Foundryman,* v. 2, June '46, p. 22-30.

Detailed description of a British foundry's method of casting the "grand slam" and "tallboy" bombs.

14-189. The Metallurgical and Engineering Status of Cast Irons. R. W. Lindsay. *American Foundryman,* v. 9, June '46, p. 31-34.

Points out how the application of metallurgical principles has improved cast iron in recent years, and emphasizes some of the consequent improvements of the engineering qualities of the material.

14-190. 50 Years' Progress in Foundry Pig Iron. T. G. Johnston. *American Foundryman,* v. 9, June '46, p. 36-40.

Early developments; alloy sensitivity; improved production; furnace design; melt components; cost reductions; grading system; analysis variation; standards improved.

14-191. Magnesium Alloy Castings—Relative Significance of Design and Metallurgical Factors to Serviceability. George H. Found. *American Foundryman,* v. 9, June '46, p. 43-49.

Factors affecting fatigue properties and serviceability which have been learned from experience.

14-192. Preventing Veining and Penetration on Castings Made in Synthetic Sands. R. E. Morey and J. R. Kattus. *American Foundryman,* v. 9, June '46, p. 53-63.

Elimination of most veining on bronze castings can be accomplished by proper melting practice because this tends to reduce the amount of dissolved gases in the molten metal. Sand techniques which help to eliminate veining by preventing the mold from cracking were developed. Washes containing finely divided refractories stop penetration of filling interstices in the surfaces of molds and cores. Mechanism of veining on gray iron castings is similar to that on bronze; veins on steel castings form only at locations where hot tears occur.

14-193. Malleable Foundry Coremaking Practice. D. F. Sawtelle. *American Foundryman,* v. 9, June '46, p. 71-74.

Core sand in a mechanized malleable foundry making pipe fittings and small castings must primarily meet the requirements of the core shop in making cores which, after performing their functions in molds, become the basis for a satisfactory molding sand.

14-194. Japanese Foundry Industry Found Inferior. A. C. Den Breejen. *American Foundryman,* v. 9, June '46, p. 81-83.

Sand technique; description of molder's tools; description of product.

14-195. Light Metals Foundry. *Metal Industry,* v. 68, June 21, '46, p. 490-491.

Sand foundries and pressure die-casting shops at V. D. M., Frankfurt, produced castings of great importance to the German war effort, such as those for V-1, rocket projectiles, and gas turbines. Foundries were not modern, but evidence of progressive and competent technical direction was to be seen.

14-196. Controlling Aluminum Melting Temperature. Wayne H. Gunselman. *Foundry,* v. 74, July '46, p. 91, 216.

Maximum temperature attained in relation to pouring temperature of casting has a decided effect on the ultimate grain size and soundness of casting. Degree of vari-

ation between maximum temperature and pouring temperature is just as critical as pouring casting at proper temperature.

14-197. **Cupola Melting of Cast Iron.** Donald J. Reese. *Foundry,* v. 74, July '46, p. 92-93, 197-203.

Deals with problems of melting department of a small gray iron foundry. Problems include equipment, raw materials, operating techniques, chemistry, metallurgy, ladle treatments, metal distribution, pouring temperatures, pouring rates and those factors which determine whether products are sound, machinable, or of sufficient quality to render an adequate service performance. Latter factors are concerned with visual or hidden defects, hard spots, casting stresses, dimensional precision and certification that the desired mechanical properties are present in the parts produced.

14-198. **Eliminating Defects in Nonferrous Centrifugal Castings.** Nathan Janco. *Foundry,* v. 74, July '46, p. 94-95, 212-213.

Corrective measures for more common types.

14-199. **Foundry Research at American Cast Iron Pipe Co.** Edwin Bremer. *Foundry,* v. 74, July '46, p. 97-99, 218-220.

Present research activities are directed by the president of the firm and works manager, with a committee composed of the heads of various departments including chemical, metallurgical, foundry, melting, pipe plants, engineering and mechanical. Research staff centers around a nucleus of 15 men whose services are amplified with those of others as the need demands.

14-200. **Developments in the Malleable Iron Industry.** Carl F. Joseph. *Foundry,* v. 74, July '46, p. 105, 217-218.

Review of recent developments.

14-201. **Internal Stresses in Centrifugal Cast Steel Tubes.** J. Caillaud. *Engineers' Digest (American Edition),* v. 3, June '46, p. 302.

Inner stresses after the cooling down of the tube or after heat treatment following the casting are due to segregation of material by centrifugal forces. The first particles to solidify are dendrites, which have a low carbon content; upon solidifying, they are subject to centrifugal forces which in magnitude exceed several hundred times the force of gravity. They are forced to the outer circumference of the casting, and this results in a relative increase of the carbon content of the steel liquid material so that the carbon content of the finished tube increases toward the inner diameter. (Abstracted from *Le Genie Civil,* v. 123, no. 1, Jan. 1, '46, p. 12.)

14-202. **Mass Production of Tank Wheels in Black-Heart Malleable.** *Foundry Trade Journal,* v. 79, June 13, '46, p. 153-160.

Discussion of paper by A. B. Bill and J. Peers read before the East Midlands branch of the Institute of British Foundrymen and published in *Foundry Trade Journal* for May 23 and 30.

14-203. **Steps in the Lost-Wax Process of Precision Casting.** *Mechanical Engineering,* v. 68, July '46, p. 637-639.

Photographs illustrate precision casting by Haynes Stellite, Kokomo, Ind., described in *Mechanical Engineering* for May.

14-204. **German Alloys—Treatment of Aluminum and Copper-Base Materials.** *Metal Industry,* v. 69, July 5, '46, p. 12-13.

Description of visit to foundry of Robert Bosch plant reported to British Intelligence Objectives Subcommittee. Light metals foundry; scrap recovery; composition and uses of alloys produced.

14-205. **German Die Castings Made by Hot Shot Gooseneck Method.** J. R. Townsend. *Product Engineering,* v. 17, July '46, p. 81-83.

Die casting machines are vertical presses with metal injected from bottom of the stationary lower die, forced up vertically and spread out horizontally to fill the mold. Elaborate tooling is used for opening dies, ejecting castings and removing cores. The equipment gives a successful process for manufacture of magnesium die castings by the hot charge method and is worthy of further study and improved engineering design to overcome some of the hazards.

14-206. **Cast-to-Shape Toolsteels.** *Steel,* v. 119, July 22, '46, p. 84, 128.

Require minimum finish machining, thus accomplishing savings in labor, material, and processing costs.

14-207. **Wartime Developments in Steel Castings.** G. Vennerholm. *Metal Progress,* v. 50, July '46, p. 75-80.

Reviews most notable wartime developments and effect these have had on present-day practice. Melting; molding; alloys and heat treatment; inspection and control; typical applications; special casting methods—centrifugal and precision casting.

14-208. **Control of Shrinkage Porosity and Mechanical Properties in Chill-Cast Phosphor Bronzes, Leaded Bronzes and Gun Metals. Part I.** W. T. Pell-Walpole. *Metallurgia,* v. 34, June '46, p. 85-90.

Variables in the chill-casting process which affect the extent and distribution of shrinkage porosity have been examined Rate of pouring is most important factor, and freedom from most harmful types of shrinkage porosity is obtained when the rate is related to the shape and size of the ingot by the formula $R = KP$, where R is the pouring rate, P is the periphery of the ingot cross section (or in the case of cored sticks, the sum of the peripheries of mold and core), and K is a constant, which for constant mold conditions and pouring temperature depends on the alloy composition. Values of K determined for all standard bronze compositions.

14-209. **Centrifugal Casting in Germany.** *Iron Age,* v. 158, July 25, '46, p. 46-48.

Report on the status of centrifugal casting practice in Germany immediately after V-E day. (Condensed from report prepared by James T. MacKenzie for the U. S. Technical Field Information Agency.)

14-210. **Fluidity Testing of Foundry Alloys.** K. L. Clark. *American Foundryman,* v. 10, July '46, p. 35-46.

Published work on fluidity appraised and certain recommendations offered. 105 ref.

14-211. **Precision Casting Process.** *American Foundryman,* v. 10, July '46, p. 74-82.

Description of the methods utilized at Haynes Stellite, together with a brief description of the type of casting to which these methods are applicable, some of its attributes and limitations, with typical examples of its application. 27 ref.

14-212. **High-Strength Aluminum Bronze Castings.** Jean Duport. *Foundry Trade Journal,* v. 79, July 4, '46, p. 245-246.

Two of the complex problems encountered are choice of the aluminum content and determination of the ternary or quaternary constituents of the alloy. (Translated from *Fonderie,* April 1946.)

14-213. **Drying of Foundry Sand Cores by Dielectric Heat.** J. R. Calhoun, L. E. Clark, and H. G. Salzberg. *Industrial Heating,* v. 8, July '46, p. 1179-1189.

Virtual elimination of heating-up period permits moisture evaporation in less than one-tenth of time required now in conventional core ovens. Low temperature developed within the core introduces additional advantages which provide more uniform cores and economies in handling them.

14-214. **Core-Making Operations.** J. H. List. *Iron and Steel,* v. 19, July '46, p. 431-432.

Experiences in producing castings for pump propeller.

14-215. **Experiences With Balanced Air Feed in the Cupola.** T. H. Taft and H. A. Hallett. *Foundry Trade Journal,* v. 79, July 11, '46, p. 263-270.

Remarkable improvements in control of the melting conditions can be obtained by paying attention to the air feed which forms a constituent of combustion. Irregular tuyere feeds cause the combustion zone to take up an eccentric position, resulting in one-sided erosion of the lining and irregular distribution of heat across cupola bore.

14-216. **Gas in Molten Magnesium Alloys.** *Light Metals* v. 9, July '46, p. 369-371.

Practical review of current thought on problem with reference to an American method of degassing ultralight alloys.

14-217. **Metallurgy in the Nonferrous Foundry, Part IX.** A. C. Boak. *Canadian Metals & Metallurgical Industries,* v. 9, July '46, p. 20-24, 49.

Casting nickel silver and other high-nickel alloys.

14-218. **Organic Compounds of Silicon.** A. E. L. Jervis. *Chemical Age,* v. 55, July 13, '46, p. 39-41, 47.

Notes on the uses of organic compounds of silicon with emphasis on their use in precision casting.

14-219. **Elimination of Casting Defects.** George Johnstone. *Foundry,* v. 74, Aug. '46, p. 76-78, 164, 166, 168, 170.

Responsibility of foundry management in eliminating casting defects is discussed.

14-220. **Permanent Molds for Casting Aluminum.** Vincent J. Sedlon. *Foundry,* v. 74, Aug. '46, p. 82-84, 192, 194.

General factors involved in use of the permanent mold process in casting aluminum. Discloses advantages and disadvantages of method by comparison with sand mold method and deals in a general way in designing, making and use of the mold to produce aluminum castings.

14-221. **A Comparison of Precision Casting Methods.** W. A. Morey. *Foundry,* v. 74, Aug. '46, p. 85, 216, 218, 220.

The investment, plaster mold, and die-casting processes.

14-222. **Sand Reclamation for the Ferrous Foundry.** E. C. Jeter. *Foundry,* v. 74, Aug. '46, p. 87-89, 172.

Two methods of reclamation have been developed to produce sand with properties approaching those of new sand. They are the wet method of scrubbing and classification, which is now in use and has actual operating experience behind it, and the roasting and dry scrubbing method, which has only numerous experiments behind it.

14-223. **Casting Turbogenerator Parts.** *Foundry,* v. 74, Aug. '46, p. 90-91.

Sand molding and loam molding, for casting low pressure exhaust end cover and the base for an 80,000-kw. turbine generator are shown and discussed.

14-224. **Aluminum Foundry Alloys.** E. Carrington. *Metal Industry,* v. 69, July 19, '46, p. 45-48.

Selection of aluminum alloys for various applications; alloys available during war; possible commercial requirements; methods of classification; foundryman's point of view; preparation of the type of alloy selected.

14-225. **The Process and Application of Lost Wax Casting.** H. W. Giesecke. *Tool Engineer,* v. 16, July '46, p. 42-44.

Permits precision casting of hard alloys. Essentials of the process; details of typical parts for which the method is advantageous; step-by-step description of the process.

14-226. **Fineness Test of Molding Sand.** Margaret Price and Alexander I. Krynitsky. *Journal of Research of the National Bureau of Standards,* v. 36, June '46, p. 521-541.

Study to evaluate merits of the regular pipette, the Andreasen pipette, and the hydrometer methods in making fineness determinations on Albany and Lumberton molding sands. Hydrometer method found to be preferable because it yields satisfactory results conveniently with a minimum expenditure of time for the operator. 11 ref.

14-227. **Metal-Faced Pattern Equipment.** A. N. Whipp. *Foundry Trade Journal,* v. 79, July 18, '46, p. 299-300.

Serviceable metals for facing; vulnerable points; correct fixing.

14-228. **Mass-Production Precision Casting.** *Machinery (London),* v. 69, July 18, '46, p. 65-73.

Details of the lost-wax technique. Some of the advantages of precision casting.

14-229. **Permanent-Mold or Die Cast?** Herbert Chase. *Machine Design,* v. 18, Aug. '46, p. 140-144.

Merits of each casting method for copper-base alloys are compared to assist in selection.

14-230. **Aluminum Sand Castings.** *Steel,* v. 119, Aug. 12, '46, p. 80-82, 84.

Aluminum foundry turns out approximately 600 different patterns of various sizes and uses 26 aluminum alloys. Describes some of the facilities utilized.

14-231. **Aluminum Foundry Alloys. (Concluded.)** E. Carrington. *Metal Industry,* v. 69, July 26, '46, p. 69-72.

Founder's requirements; expansion and contraction; preparation of the alloy; use of scrap; effect of gas; removal of gas; use of fluxes. 4 ref.

14-232. **Die Casting Outboard Motor Parts.** Herbert Chase. *Iron Age,* v. 158, Aug. 15, '46, p. 50-53.

Production of aluminum die-cast outboard motor parts at the plant of Johnson Motors, Waukegan, Ill. Equipped with 22 casting machines, plant is reported to be the first all-electric die-casting installation in that induction heated melting and holding furnaces are used exclusively. Gate removal, casting cleaning and finishing, use of inserts and handling methods used are described in detail.

14-233. **Centrifugal Castings.** *Western Machinery and Steel World,* v. 37, Aug. '46, p. 94-96.

True centrifugal castings, centrifuging or pressure casting, pressure gradient, casting analyses. 11 ref.

14-234. **The Fluidity of Cast Steel—Its Measurement, Its Meaning and Its Value to the Foundryman.** H. F. Taylor. *Electric Furnace Steel Proceedings A.I.M.E.,* v. 3, 1945, p. 252-256; discussion, p. 256-281.

The fluidity spiral method for determination of proper tapping time. Graphs show influence of manganese, nickel, chromium, molybdenum, and vanadium on the fluidity of cast steels; influence of carbon content on fluidity of killed steels; effect of carbon content on fluidity of steels with average manganese and silicon content; and fluidity of steels alloyed to give maximum castability.

14-235. **Skimmer Screens for Nonferrous Castings.** E. T. Myskowski and H. F. Taylor. *American Foundryman,* v. 10, Aug. '46, p. 24-29.

Defects caused by dirt can be largely eliminated in copper-base alloy castings by the use of perforated steel sheets. Inserted in the ingate of the mold, the screen prevents dirt and dross from entering the mold cavity. Cleaning costs can be reduced by insertion of the screen in the mold cavity at the junction of risers and casting.

14-236. **Malleable Foundry Core Sand Practice.** Joseph J. Clark. *American Foundryman,* v. 10, Aug. '46, p. 61-69.

Sources and selection of sand; control of incoming sand; drying; fines removal; selection, storage and control of other raw materials; core sand mixing equipment, mixtures and mixture control; core-making equipment; core baking.

14-237. **Exothermic Materials.** C. G. Lutts, J. P. Hickey and Michael Bock II. *American Foundryman,* v. 10, Aug. '46, p. 71-76.

New types of exothermic materials in concentrated form for addition to risers, providing great heat at the proper place for producing directional solidification. Results of tests are given for steel, monel metal and corrosion resistant steel.

14-238. **Wrought Copper Alloys.** *Metal Industry,* v. 69, Aug. 9, '46, p. 115-118.

German methods for continuous casting of extrusion billets. From a report by the Combined Intelligence Objectives Subcommittee investigating German industry.

14-239. **Good Pattern Practice for Foundries.** J. A. Burgard. *Western Metals,* v. 4, Aug. '46, p. 22-25.

Pattern equipment; gated patterns; match plates; cope and drag types; sweeps; skeleton patterns; maintenance; joining sections; color code; draft; distortion; shrinkage; core boxes.

14-240. **Control of Shrinkage Porosity and Mechanical Properties in Chill-Cast Phosphor-Bronzes, Leaded Bronzes and Gun Metals—Parts II to V.** W. T. Pell-Walpole. *Metallurgia,* v. 34, July '46, p. 155-161.

Variables in the chill-casting process which affect the extent and distribution of shrinkage porosity have been examined for phosphor bronzes, gun metals and leaded bronzes. Rate of pouring is the most important factor, and freedom from the most harmful types of shrinkage porosity is obtained when the rate is the lowest which will fill the mold without cold shuts. This critical rate is related to the shape and size of the ingot by the formula given. Mechanical properties of these bronzes in general vary with casting conditions in the same manner as density—i.e., optimum values are obtained, uniformly across the section, when the pouring rate is the minimum which will fill the mold without cold shuts. Slight variations in properties are also produced by the effect of pouring and mold temperature on the distribution of the brittle compound phases.

14-241. **Report of the American Foundrymen's Association Committee on Aluminum Casting Stability.** *Aluminium & the Non-Ferrous Review,* v. 2, April-June '46, p. 26-28, 30, 32.

Report covers difficulties encountered with aluminum castings that are machined after heat treatment.

14-242. **Aluminum Alloy Die Casting.** *Aluminium & the Non-Ferrous Review,* v. 2, April-June '46, p. 40, 42-48.

Die-casting dies; casting ejection mechanism; die-casting machines; volume of metal; metal temperature control; metal analysis control; difficult to cast; redesigning; trimming die castings; inspection; aluminum die casting applications.

14-243. **Mold Dressings.** W. T. Pell-Walpole. *Metal Industry,* v. 69, Aug. 16, '46, p. 129-134.

In order to obtain maximum internal soundness in bronze ingots cast in chill molds the necessary conditions

of porosity demand a mold dressing which can be used thinly but which must be strong. Describes experimental work on the development of a suitable dressing.

14-244. **New Developments in Magnesium Foundry Technology.** Louis A. Carapella. *Aluminum and Magnesium,* v. 2, Aug. '46, p. 10-13, 19.

Melting and refining fluxes; melting without fluxes; melting processes, equipment and capacities; settling out of impurities.

14-245. **Magnesium Foundry Core Practice.** George W. Kurachek. *Foundry,* v. 74, Sept. '46, p. 76-77, 162, 164, 166, 168, 170.

New developments: Resin core binders; low temperature core oils; inhibitors.

14-246. **Navy Yard Revamps Foundry.** Pat Dwyer. *Foundry,* v. 74, Sept. '46, p. 78-82, 182, 184.

First of two articles describing the foundry modernization program completed during the war at the Norfolk Navy Shipyard.

14-247. **Test Bars for 85-5-5-5 Alloy. Part 1.** G. H. Clamer. *Foundry,* v. 74, Sept. '46, p. 84-89, 125, 128.

Battelle research for the Non-Ferrous Ingot Metal Institute. Work to date has been devoted to evaluation of test-bar design. Eleven designs were considered and eight were investigated in detail. Includes detail drawings of each type and photomicrographs. (1946 Foundation Lecture to the American Foundrymen's Association.)

14-248. **The Stability of Iron Carbide.** Lester Crome. *Foundry,* v. 74, Sept. '46, p. 90-91, 128, 130.

Effects of repeated malleableizing, carburizing and decarburizing atmospheres, carburizing compounds and various elements as ladle additions on the equilibrium $Fe_3C \leftrightharpoons 3Fe + C$ in the manufacture of malleable cast iron.

14-249. **Elimination of Casting Defects. Part 2.** George Johnstone. *Foundry,* v. 74, Sept. '46, p. 92-95, 210, 212, 214-215.

Classification and prevention of defectives; inspection methods.

14-250. **Ventilating Separators, Breakers, and Screens.** C. C. Hermann. *Foundry,* v. 74, Sept. '46, p. 97, 215-216, 218.

Recommended methods for dust elimination in foundry sand reclamation.

14-251. **The Production of "Grand Slam" Bomb Castings.** Basil Gray. *Foundry Trade Journal,* v. 79, Aug. 8, '46, p. 361-372; discussion, Aug. 15, '46, p. 395, 397-399.

Unusual method for constructing the core.

14-252. **Ethyl Silicate in the Foundry.** Pierre Nicolas. *Foundry Trade Journal,* v. 79, Aug. 15, '46, p. 401-402.

Preparation of the pattern; coating the pattern; bedding-in the pattern; hardening in mold; preparation of the mold for casting; melting and casting; finishing; existing field; future uses.

14-253. **Gravity Die Casting. Part I.** R. Hinchcliffe. *Metal Industry,* v. 69, Aug. 23, '46, p. 151-152.

Characteristic properties of aluminum and its alloys in so far as they affect the process of gravity die casting.

14-254. **Nonferrous Alloy Castings; Gas Elimination.** George Dalbey. *American Foundryman,* v. 10, Sept. '46, p. 22-34.

Gas in nonferrous alloys may be eliminated in large part by holding the gas-contaminated metal for a sufficient period at a temperature above its melting point in an atmosphere relatively free of the contaminating gas. Experiments also indicate that a drop in temperature during the holding period is not necessary to secure elimination of a large part of the gas.

14-255. **Foaming of Bearing Metal During Casting.** E. A. Wolfenden. *Metal Progress,* v. 50, Sept. '46, p. 479-480.

White metal alloy from a new shipment was added to a pot containing the same type of alloy. At about 15% new metal, the metal showed a tendency to froth while being poured into the bearing backs. Cause of this frothing and methods for correction based on advice of various experts.

14-256. **Synthetic Sand Practice.** J. J. Marais. *Foundry Trade Journal,* v. 79, Aug. 22, '46, p. 413-419.

Special problems of the South African foundry industry.

14-257. **Permanent Mold Aluminum Casting.** William Helme. *Industrial Gas,* v. 25, Sept. '46, p. 14-16, 32-33.

Foundry processes and equipment at Alumicast Corp., Chicago.

14-258. **Gravity Die Casting. (Continued.)** R. Hinchcliffe. *Metal Industry,* v. 69, Aug. 30, '46, p. 174-176.

The problem of solidification, and the proper gating and feeding methods required.

14-259. **Hot-Tearing Tendencies of Aluminum Casting Alloys.** D. G. C. Lees. *Foundry Trade Journal,* v. 80, Sept. 5, '46, p. 17-19.

Hot-tearing behavior of a number of commercially used alloys studied under controlled conditions. Mechanism of hot-tearing; recommendations for its avoidance.

14-260. **Fluidity Testing of Foundry Alloys. (Continued.)** K. L. Clark. *Foundry Trade Journal,* v. 80, Sept. 5, '46, p. 11-16.

Skimmers; temperature measurement and transfer of metal to test mold; sampling from bottom-pouring ladles; shop tests vs. laboratory tests; summary of recommendations. 105 ref.

14-261. **New Developments in Magnesium Foundry Technology, Part II.** Louis A. Carapella. *Aluminum and Magnesium,* v. 2, Sept. '46, p. 18-20, 23.

Use of reverberatory furnaces, the pumping of molten magnesium, and the continuous casting of alloy ingots are some revolutionary steps away from batch operations and toward continuous procedures. Much attention will be given to nonsuperheating methods of grain refinement in castings made from magnesium alloys containing aluminum. Bubbling of a chlorine-carbon-tetrachloride mixture through the melt may have commercial possibilities.

Mixture is claimed to clean, de-gas, and grain-refine the melt, all in a single operation.

14-262. **Mold and Core Materials.** N. J. Dunbeck. *Western Metals,* v. 4, Sept. '46, p. 51-52, 54-56, 58-62.

Effects of sand properties upon yield of good castings, their appearance and dimensional accuracy. Describes briefly materials other than sand sometimes used in production of castings.

14-263. **Flushing Aluminum With Nitrogen Gas.** A. C. Boak and G. A. Allen. *Canadian Metals & Metallurgical Industries,* v. 9, Sept. '46, p. 16-21, 39.

Valuable results indicated by Canadian investigation. Tests and results.

14-264. **Removing Dissolved Gases From Molten Metals. Part I.** P. M. Hulme. *Steel,* v. 119, Oct. 7, '46, p. 108-111, 160, 163.

Most efficient and economical method of removing harmful gases from molten metals is known as "flushing", and consists of bubbling a dry, inert gas through the metal just before casting.

14-265. **Brass Die Casting.** Herbert Chase. *Steel,* v. 119, Oct. 7, '46, p. 112-114, 164, 166, 169-170.

Offers strength, hardness, wear and corrosion resistance. Equipment and procedure used at Titan Metal Mfg. Co., Bellefonte, Pa.

14-266. **Thin-Walled Steel Castings.** *Iron and Steel,* v. 19, Sept. '46, p. 507-510.

Notes on the influence of pouring speed.

14-267. **Sand Cast and Permanent-Mold Cast Aluminum Alloy Parts.** Walter J. Klayer. *Product Engineering,* v. 17, Oct. '46, p. 81-85.

Physical properties of castings made by the two methods; relative costs and production rates compared. Dimension tolerances, allowable radii, draft and other design data that belong essentially to design parts, but which are defined by the molds in which the parts are cast, are treated with the view to being compatible with good mold design.

14-268. **Use of Petroleum Distillation Extracts to Replace Linseed Oil in Core-Binders.** *British Steelmaker,* v. 12, Sept. '46, p. 439-440.

Replacing linseed oil in core-binders by aromatic extracts removed by solvents from the lubricating oil fraction of crude petroleum. (Results of investigation by Steel Castings Research Committee.)

14-269. **Fluidity Testing of Foundry Alloys.** K. L. Clark. *Foundry Trade Journal,* v. 79, Aug. 29, '46, p. 443-450.

Objective of the Committee on Fluidity Testing of the American Foundrymen's Association is to determine if a single, standard fluidity test which is reasonably suitable for all foundry alloys can be adopted by the industry so that data from many sources can be compared directly. Published work on fluidity is appraised and certain recommendations are offered.

14-270. **Removing Dissolved Gases From Molten Metals. (Concluded.)** P. M. Hulme. *Steel,* v. 119, Oct. 14, '46, p. 110-111, 122, 125-126 128.

Five types of flushing gas employed for producing artificial boil of molten metal. Gas is ejected below surface of metal through bare iron pipe or modified ladle stopper rod assemblies.

14-271. **Pattern Records. (Continued.)** Frank C. Ceon. *Foundry,* v. 74, Oct. '46, p. 86-87, 202, 204, 206, 208.

Lists the requisites for an adequate system of pattern records.

14-272. **Correction of Foundry Waste.** A. J. Edgar. *Foundry,* v. 74, Oct. '46, p. 94-95, 168, 174, 176.

Where to look for waste in gray iron foundry operation. Amount of coke required; fuel affects carbon content; five zones in cupola; blows traced to nails; gates are either good or bad; cleaners are careless.

14-273. **Centrifugal Casting of Steel in Wartime Germany.** Charles W. Briggs. *Foundry,* v. 74, Oct. '46, p. 96-97, 255, 256-259.

Use of sand liners and water-cooled molds, which were among the principal German wartime developments in centrifugal casting of steel.

14-274. **Microporosity in Magnesium Alloy Castings.** Herbert Dobkin. *Foundry,* v. 74, Oct. '46, p. 98-101, 178, 180, 182.

Various theories for occurrence of microporosity in magnesium castings; means for minimizing the condition.

14-275. **Small Brass Foundry Operated on Third Floor.** Edwin Bremer. *Foundry,* v. 74, Oct. 46, p. 102-103, 242-243.

Brief notes on plant and equipment.

14-276. **Test Bars for 85-5-5-5 Alloy. (Concluded.)** G. H. Clamer. *Foundry,* v. 74, Oct. '46, p. 104-107, 184, 186, 188, 190, 222.

Investigation of effects of pouring temperature, height, speed, mold tilt and permeability, and moisture content of the sand.

14-277. **Navy Yard Revamps Foundry. (Concluded.)** Pat Dwyer. *Foundry,* v. 74, Oct. '46, p. 112-115, 195-196, 198, 200, 202.

Description of modernized foundry of the Norfolk Naval Shipyard. Adoption of standardized practice in every phase of operation—molding, melting, coremaking and cleaning.

14-278 **Gravity Die Casting. (Concluded.)** R. Hinchcliffe. *Metal Industry,* v. 69, Sept. 6, '46, p. 193-195.

Mechanical design of gravity dies; illustrations of some difficult die castings.

14-279. **A Study of Resinous Sealants for Porous Metal Castings.** Vernon C. F. Holm. *Journal of Research of the National Bureau of Standards,* v. 37, Sept. '46, p. 177-178.

Repair of porous castings by sealing with liquid synthetic resins was investigated. Sealing efficiencies of 14 resins were determined on porous bushings of aluminum,

a copper-silicon alloy, and a red brass, impregnated by the vacuum-pressure method. Tests were made to determine the durability of the two most promising sealants. Results suggest that this procedure for rendering porous castings pressure tight may be permissible in emergencies but that, in general, the foundryman should exert every effort to produce nonporous castings instead of trying to remedy porosity.

14-280. **Centrifugal Casting in Germany.** *Steel,* v. 119, Oct. 21, '46, p. 100-101, 130, 132.

Survey shows that at V-E day, German ferrous and nonferrous practice in general compared favorably to ours. Use of thin mold consisting of clean silica sand spun just before casting may represent real advance in manufacturing heavy tubing.

14-281. **Skulls Prevented by Boron Nitride.** E. Epremian. *Metal Progress,* v. 50, Oct. '46, p. 661.

Molten metal sticking in furnace mouths and forming skulls in small ladles may be eliminated by painting a mixture of boron nitride and water on the warmed surface. This technique was found particularly useful with precision casting furnaces.

14-282. **The Influence of Foundry Technique on the Malleability of Metals and Alloys.** P. Bastien. *Engineers' Digest (American Edition),* v. 3, Sept. '46, p. 469-472.

Malleability tests permit general conclusions about the malleability of a metal or alloy, and abbreviate costly preparatory work in rolling and forging mills. The tests also permit studying the influence of various factors on the malleability. (Condensation from *Fonderie,* no. 3, March '46, p. 99-109.)

14-283. **Centrifugal Casting.** *Engineers' Digest (American Edition),* v. 3, Sept. '46, p. 474.

Advances in technology and application since World War I. (Condensed from *Technische Rundschau, Switzerland,* v. 38, May 24, '46, p. 1-3, 21.)

14-284. **Methods of Making Cast-Iron Shells.** B. Levy. *Foundry Trade Journal,* v. 80, Sept. 19, '46, p. 71-72.

Correlation of various proposals of practical methods for making cast-iron shells. Includes working diagrams.

14-285. **The Function of the Laboratory in Aluminum Foundries.** E. Carrington. *Metallurgia,* v. 34, Sept. '46, p. 238-244.

Its function is to check the composition and physical properties of the metal, exercise technical control over manufacturing processes, and to institute a system of inspection on castings produced. There should be mutual respect between metallurgist and the foundrymen to facilitate collaboration and the promotion of confidence in the contribution of each to the production of better and cheaper castings.

14-286. **Precision Casting Methods Compared.** W. A. Morey. *Machine Design.* v. 18, Oct. '46, p. 83-86.

Advantages, limitations and precision level of each method; comparison of costs and production characteristics.

14-287. High-Tensile Alloy Steel Castings. J. F. B. Jackson. *Foundry Trade Journal,* v. 80, Sept. 26, '46, p. 83-89; discussion, p. 89-90, 94.

Steelmaking; heat treatment; radiographic inspection; cement-sand molding; applications of high-tensile steel castings; properties of high-tensile steel castings. (Abstract of paper read before a joint meeting of the West Scotland branch of the Association of Mining, Electrical and Mechanical Engineers, the West of Scotland Iron and Steel Institute and the Institute of British Foundrymen.)

14-288. Melting Fluxes for Aluminum. *Light Metals,* v. 9, Oct. '46, p. 525-528.

Preparation of molten aluminum alloys for casting; function of the various treatments; need for standardization of practice.

14-289. New Die Casting Applications With Prefill Injection Method. Sanford Markey. *Production Engineering & Management,* v. 18, Oct. '46, p. 56-60.

New procedure virtually eliminates porosity, thus giving greater strength and utility to nonferrous castings.

14-290. Phenolic Resin Core Binders. *Gray Iron Progress,* v. 3, Oct. '46, p. 4-7.

Advantages of resin cores are: they give high strengths comparable to oils; they cure much faster than oils, especially in thick sections; their gas evolution is low; they do not form obnoxious gases and smoke during baking and pouring.

14-291. Magnesium Castings Quality—Effect of Mold Materials. M. V. Chamberline and J. G. Mezoff. *American Foundryman,* v. 10, Oct. '46, p. 24-38.

Chilling capacity of a mold material depends directly upon its thermal conductivity and its heat capacity; chilling capacity of a heterogeneous mold is particularly sensitive to the intergranular area of contact and to the thermal conductivity of the film separating the grains; use of steel shot core sand, or of zircon core sand, provides slightly greater chilling capacity than does silica sand, but this increase is deemed insufficient to justify their use for the production of magnesium castings; high cooling rates contribute to high tensile properties and casting soundness primarily through the promotion of adequate thermal gradients; and dissolved gas is detrimental to casting soundness when feed metal or feeding pressure is inadequate.

14-292. Silicon Pickup in Melting Malleable Iron. J. E. Rehder. *American Foundryman,* v. 10, Oct. '46, p. 50-54.

A correlation of the theory of silicon pickup with data obtained in normal malleable iron melting practice shows that high temperature, high carbon contents, time at high temperatures, and high silica content of refractories and slag are factors promoting increased silica content.

14-293. Knock-Off Risers, Nonferrous Castings. S. W. Brinson. *American Foundryman,* v. 10, Oct. '46, p. 55-62.

A greater number of sound castings as well as easier knock-off of risers is obtained with nonferrous than ferrous castings. Perforated metal screens and graphite

carbon disks effect distinct economies in the cleaning of risers, and function best in brass risers not in excess of 5 in. diameter. Graphite carbon disks function with equal effectiveness in both brass and bronze risers, and in all sizes of risers highest economies are realized when the number of castings is large or when the risers themselves are large. For the same amount of feeding, gypsum sleeves enable the use of risers approximately 30% smaller than conventional gravity-feed type risers.

14-294. **Core Sand Purchasing Factors.** H. Louette, A. E. Murton, and H. H. Fairfield. *American Foundryman,* v. 10, Oct. '46, p. 63-65.

Test results show that shape of the sand grain has a profound influence upon the properties of core sand mixtures. Preference should be given to a sand with rounded, smooth-surfaced grains. Low-power microscope is a useful tool in estimating the suitability of core sands.

14-295. **Gray Iron Castings Section Sensitivity.** Henry C. Winte. *American Foundryman,* v. 10, Oct. '46, p. 68-75.

Physical properties of a casting may be predicted from a test bar only when the cooling rate of the test bar is comparable to that of the casting. Relation between section size and tensile strength has been worked out in graphic form, enabling the engineer to select an iron which will meet design requirements of the casting.

14-296. **Aluminum Permanent Mold Methods in a Modern Foundry.** *Light Metal Age,* v. 4, Oct. '46, p. 20-21.

Brief account of facilities of Hampden Brass & Aluminum Co.

14-297. **Pressure-Tight Phosphor Bronze Castings.** Richard H. Lambert and Vincent DePierre. *Foundry,* v. 74, Nov. '46, p. 66-67, 131, 134.

During the war it became necessary to procure bronze castings for optical units which were dense enough to hold inert gas under pressure indefinitely to prevent entrance of moisture. Investigations indicated that porosity was due to evolution of dissolved hydrogen. Three methods were tried for elimination of gases from the molten bronze, each consisting of adding oxygen and removing it before pouring by adding phosphor copper. A method using a flux of 50% copper oxide and 50% potassium nitrate proved satisfactory.

14-298. **Mechanize Bathtub Foundry.** Pat Dwyer. *Foundry,* v. 74, Nov. '46, p. 68-73, 156.

Details of layout, equipment and procedures used by Richmond Radiator Co. at Monaca, Pa.

14-299. **Steel Castings Produced Centrifugally.** Edwin Bremer. *Foundry,* v. 74, Nov. '46, p. 78-81, 194, 196.

Equipment and practices employed by the Youngstown Alloy Casting Corp.

14-300. **Matchplate Patterns From Phenolic Casting Resin.** C. R. Simmons. *Foundry,* v. 74, Nov. '46, p. 123-124, 126.

Numerous applications of this process as perfected by Atlas Plastics, Inc.

14-301. **Formulas for Determining the Weights of Castings.** *Foundry,* v. 74, Nov. '46, p. 137.

Formulas and tables given for eight castings shapes.

14-302. **Casts Threading Dies in New Gray Iron Foundry.** Walter Rudolph. *Foundry,* v. 74, Nov. '46, p. 166, 168.

Castings of a specialty product. The metal is poured into a mold containing the die's steel chasers; these chasers, which do the actual cutting of threads when the die is used, must be welded firmly and in proper position in the iron casting.

14-303. **Permanent Mold Gray Iron Castings.** Edward C. Hoenicke. *Materials & Methods,* v. 24, Oct. '46, p. 901-904.

Absence of surface hardness and scale, and the fine-grained, uniform structure of permanent mold gray iron castings permit easier machining, higher cutting speeds and faster feeds. Saving in machining has been estimated at as high as 15 to 20%. Eaton permanent mold machine which produces these castings is described.

14-304. **Centrifugal Casting in the Shipbuilding Industry.** N. N. Socolov. *Engineers' Digest,* v. 3, Oct. '46, p. 509.

Details of a centrifugal casting machine for the casting in metal molds of bronze ship propellers of up to 700 mm. ($27\frac{9}{16}$ in.) diameter. (From *Sudostroenye,* no. 3-4, 1945, p. 25-31.)

14-305. **Lost-Wax Casting.** H. W. Giesecke. *Westinghouse Engineer,* v. 6, Nov. '46, p. 180-182.

Application of process to manufacture of such parts as gas turbine blades, that use nonforgeable or nonmachinable alloys.

14-306. **Bronze Castings.** Harold J. Roast. *Canadian Metals & Metallurgical Industries,* v. 9, Oct. '46, p. 25-31.

Important questions on materials and methods answered largely on the basis of practical foundry operations. (Paper presented before Maritimes Meeting, Eastern Canada and Newfoundland Chapter, A. F. A.)

14-307. **Permanent-Mold Casting of Pistons by Chrysler's High-Production Methods.** Charles H. Wick. *Machinery,* v. 53, Nov. '46, p. 148-157.

Melting, pouring, molding, and aging steps of a conveyerized production line process in which 33,000 pistons are cast per day.

14-308. **Selection of Die Castings.** *Metal Progress,* v. 50, Nov. '46, p. 930.

Relative characteristics of different casting methods and order of merit of four families of die castings with respect to various properties including costs. (New data sheet.)

14-309. **A New Method for Melting Magnesium.** C. H. Lorig. *Metal Progress,* v. 50, Nov. '46, p. 1020-1022.

Hydrogen in magnesium causes undesirable porosity in castings. The most reliable method of producing a melt of low gas content consisted of fluxing with chlorine. Numerous experiments on methods for grain refining led to a procedure consisting of treatment of the metal with chlorine and carbon tetrachloride prior to initial casting of the ingot. Method is applicable to lots of 1500 to 2000

lb. A method for transfer of the molten metal by use of a special centrifugal pump was also worked out to avoid gas or other contamination.

14-310. **Scientific Measurement in the Foundry.** A. Scattergood. *Foundry Trade Journal,* v. 80, Oct. 17, '46, p. 155-161.

Development of various "scientific methods" in foundry practice, in contrast to the rule-of-thumb techniques formerly employed. Included is an outline of piecework rate setting and cost estimation.

14-311. **Production of Cast-Iron Porcelain-Enameled Baths in Germany.** R. L. Hunter. *Foundry Trade Journal,* v. 80, Oct. 17, '46, p. 169-172.

Reports of 12 German plants show that none used any kind of finishing although the baths were cast from the bottom in exactly the same way as in Britain. Natural sand was used. Notable point was great care taken with patterns and boxes, a carefully machined engineering job which accounts for very light weights obtained.

14-312. **Molding and Pouring Aluminum Sand Castings.** *Modern Metals,* v. 2, Nov. '46, p. 18-21.

Gating, heading, defects, dross inclusions, blowholes, cavities, shrinkage, porosity, cracks, misruns, cold shuts and segregation problems in casting aluminum.

14-313. **Sources of Hydrogen in Cast Iron.** W. Y. Buchanan. *Foundry Trade Journal,* v. 80, Oct. 10, '46, p. 143-144.

Letter discusses recent paper by R. C. Tucker. In order to clarify the distribution of moisture in coke, which is said to be a major source of the hydrogen, experiments on the drying rate of coke which has been immersed in water and then heated to various temperatures were made. Results, which are tabulated and charted, indicate that moisture would be evaporated almost instantly at the temperature of the cupola gases, hence could play no part as a source of hydrogen.

14-314. **Improved Sealing of Porous Castings.** Oliver Pritchard. *Industrial Gas,* v. 25, Nov. '46, p. 9-11.

Use of Polyplastex resins for impregnation of porous castings.

14-315. **Fabrication Des Chemises de Cylindres Moulees en Sable et Centrifugees.** (**Production of Cylinder Shells by Centrifugal Casting in Sand.**) *Fonderie,* no. 8, Aug-Sept. '46, p. 306-307.

Method for centrifugal casting of cylinder shells. The most appropriate composition of cast steel is indicated.

14-316. **Synthetic Sand in an Aluminum Foundry.** William G. Parker. *Aluminum and Magnesium,* v. 3, Nov. '46, p. 16-19.

Importance of properly prepared sand specimen and need for properly mounted sand rammer.

14-317. **Giettemperaturen Van Zinklegeringen.** (**Casting Temperature of Zinc Alloys.**) J. H. F. Van Der Zanden. *Metalen,* v. 1, Oct. 15, '46, p. 29-32.

During sand casting of such alloys, heating of the molten metal above 500° C. improves considerably its castability, particularly in thin-walled and intricate sand

castings. Superheating of alloys up to 650° C. does not affect their mechanical properties.

14-318. **How Much Venting Power Must Green Sand Molds Possess?** E. C. Troy. *Foundry,* v. 74, Dec. '46, p. 82-85, 216, 218, 220.

A compilation of investigations relating to steel casting defects and green sand properties. Data and observations reported are the results of numerous independent experiments. Conclusions advanced have been amply supported in commercial application.

14-319. **Fluidity Testing of Foundry Alloys.** K. L. Clark. *Foundry,* v. 74, Dec. '46, p. 92-96, 244-252.

Reviews published work and offers recommendations on fluidity testing practice used to evaluate casting characteristics of foundry alloys. (Paper presented before Institute of British Foundrymen as 1946 exchange paper from American Foundrymen's Association.) 105 ref.

14-320. **The Hot Blast Cupola.** Marcel Bader. *Foundry,* v. 74, Dec. '46, p. 104-106, 252-254.

Experiences of others with hot blast cupolas; results of large-scale German tests using the hot blast cupola proposed by Piwowarsky. These tests show that malleable iron can be melted more economically and that the quality of the product is improved when the hot blast is used.

14-321. **Pattern Rigging for Production Molding.** F. C. Riecks. *Foundry,* v. 74, Dec. '46, p. 111, 234-236.

Molding operations at Ford Motor Co. Patterns and machine to which they are attached should be considered as a team; pattern and core boxes should also be considered together. Maintenance is a large factor and mechanization is essential.

14-322. **Formulas for Determining the Weights of Castings.** *Foundry,* v. 74, Dec. '46, p. 167-168.

Tables cover sector of cone frustrum, hollow sphere, triangles, hexagons, and ellipsoids. (To be continued.)

14-323. **Sealing of Porous Castings.** Prescott C. Fuller. *Aero Digest,* v. 53, Nov. '46, p. 96, 111.

Pressure-tight castings have been produced and great savings have been realized in terms of money, foundry time and machine time on cast parts that might otherwise have been rejected, by impregnation with Laminac in modified form.

14-324. **Bronze Castings, Conditions of Flow.** J. T. Robertson and R. G. Hardy. *American Foundryman,* v. 10, Nov. '46, p. 59-66.

Some factors influencing laminar and turbulent flow in bronze castings investigated with gun metal, manganese bronze and aluminum bronze. The diameter of the gate was one of the most important factors governing the linear velocity of the molten metal. Laminar flow produced the best mechanical properties, surface conditions and fracture of aluminum bronze. Laminar flow also was beneficial to manganese bronze, but had little influence on mechanical properties, surface or fracture of gun metal. 17 ref.

14-325. **Jobbing Work in an Indian Foundry.** S. G. Athanikar. *Foundry Trade Journal,* v. 80, Oct. 31, '46, p. 209-212.

Method adopted for molding a 36-in. diameter bend and a guide vane piece required for a propeller pump.

14-326. **Permanent Mold Aluminum Castings.** *Light Metal Age,* v. 4, Nov. '46, p. 8-9, 37.

Equipment and operations at Aluminicast Corp.

14-327. **Mechanical Pouring Unit Handles 11 Tons per Hour.** J. R. Shepard and W. J. Olson. *Iron Age,* v. 158, Dec. 5, '46, p. 77-80.

At American Brake Shoe a means of pouring 370 brake shoe molds an hr. has been developed. System of centralized mechanical pouring utilizes push button control. It has succeeded in converting the pouring operation of several difficult jobs requiring five to six pourers to one requiring but one operator working in safety and comfort.

14-328. **A Simple Rapid Method for Determining the Moisture Content of Sand.** P. D. Liddiard and Elizabeth Seal. *Foundry Trade Journal,* v. 80, Nov. 14, '46, p. 257-260, 271.

Describes a method based on electrical properties with instructions on constructing an electrometric unit; its calibration and use.

14-329. **The Fundamental Characteristics of Molding Sands.** W. Davies. *Iron and Steel Institute Advance Copy,* 1946, 38 p.

Geological characteristics particularly as regards the mineralogy of the clays. Mechanism of the bonding of molding sands in the light of recent hypotheses; the effects of different types of clay on the molding properties of a sand as a whole. 84 ref.

14-330. **Cast Iron. Neutralization of Sulphur by Various Alloying Elements.** H. Morrogh. *Iron and Steel,* v. 19, Nov. 21, '46, p. 719-724; discussion, p. 765-766.

Melting procedure, and subsequent tests and experiments with the various elements. Results of microscopic examination.

14-331. **Steel Castings.** F. H. Keating. *Iron and Steel,* v. 19, Nov. 21, '46, p. 725-729.

Experimental work on their production and radiography for service at high pressure.

14-332. **Coneygre Foundry.** Vincent C. Faulkner. *Foundry Trade Journal,* v. 80, Nov. 7, '46, p. 231-236.

Layout; melting practice; sand preparation; green sand foundry; core making; control and inspection; dispatch; welfare; program control.

14-333. **Improvements in the Manufacture of Tin Bronzes.** W. T. Pell-Walpole. *Metal Progress,* v. 50, Dec. '46, p. 1221-1231.

Object of a series of researches carried out in the University of Birmingham in England was to obtain bronzes in the wrought condition which would combine the established corrosion resisting properties of high-tin bronze with better mechanical properties than could be obtained either in these alloys in their normal cast condition or in lower tin bronzes in the wrought condition. Fabricating

difficulties investigated; new flux process devised; new theory of inverse segregation.

14-334. **1,000,000 Pounds of Small Die Castings.** Herbert Chase. *Steel,* v. 119, Dec. 23, '46, p. 56-58, 99-100.

Procedures used in production of die-cast zinc alloy hardware at Fisher Body's Ternstedt plant in Detroit. Control methods stress high surface smoothness to minimize polishing before plating.

SECTION XV

SALVAGE AND SECONDARY METALS

15-1. Stainless Steel Scrap. L. F. Weitzenkorn. *Blast Furnace & Steel Plant,* v. 33, Dec. '45, pp. 1511-1512, 1537-1538.

A.I.S.I. types and analyses; scrap cannot be intermixed; precautions in handling scrap.

15-2. Conserving and Reclaiming Mercury. A G. Arend. *Chemical Age,* v. 53, Dec. 1, '45, pp. 513-515.

Some early processes; conservation in lamp production; speeding-up waste recovery; treating ores; advantages of the improvements; metallic mercury cathode; mercury turbine.

15-3. A Limited Supply of Scrap Available for 1946. Edwin C. Barringer. *Blast Furnace and Steel Plant,* v. 34, Jan. '46, p. 85-86, 96.

Consumers should realize importance of according to scrap some of the long-range planning devoted to other raw materials. Scrap industry could function more efficiently and costs would be reduced if more stable markets were assured it.

15-4. Secondary Aluminum. F. H. Smith. *Metallurgia,* v. 33, Feb. '46, p. 207-209.

Conversion of aluminum scrap into suitable forms for re-use, carried out under controlled conditions to meet specified standards.

15-5. Parts Salvaged by Metalizing. Part 2. Walter J. Brooking. *Welding Engineer,* v. 31, March '46, p. 42-45.

The production steps of bonding, spraying, finish machining; economies of the process for the salvaging of mismachined parts.

15-6. Gray Iron Castings—Welding and Salvage. J. A. Griffin. *American Foundryman,* v. 9, March '46, p. 16-23.

Methods of salvaging gray iron castings through welding, brazing, arc, cylinder-bore welding, soldering and plugging.

15-7. Goodbye, Messy Chips. Sidney Reibel. *Flow,* v. 1, April '46, p. 26-27.

One of largest aluminum chip-handling systems ever built paid for itself in the first six months of operation by

reducing former handling costs and increasing value of the chips.

15-8. **Aircraft Aluminum Recovery.** *Modern Metals,* v. 2, April '46, p. 8-11.

Preparation and melting procedure adopted by the Navy for the production of ingot aluminum from aircraft.

15-9. **New Brass Foundry Typifies Modern Design.** Pat Dwyer. *Foundry,* v. 74, May '46, p. 158-163, 294.

H. B. Slater Mfg. Co., Marysville, Ohio, erected and placed in operation a complete new brass foundry. It is confidently anticipated that better working conditions, increased output and reduced operating cost will amortize the capital expenditure in less than three years. Molds are made on machines; metal is distributed efficiently.

15-10. **Recovery of Usable Metal From Aluminum and Aluminum Alloy Drosses, Turnings, Swarf, Etc.** C. F. Jinks. *Metallurgia,* v. 33, April '46, p. 302-303.

Although heavy scrap, old castings, etc., are often melted in the same way as pig metal, with no special precautions to prevent oxidation, finely divided scrap must be protected to insure recovery of usable metal economically. Successful method described..

15-11. **The Identification and Recovery of Scrap Metal.** *Machinery (London),* v. 68, May 23, '46, p. 659-663.

Preliminary cleaning of scrap; accurate methods of differentiating scrap metals; storage of scrap prior to removal to the melting plant; melting cleaned and sorted scrap. Tables give chemical or spot tests and compositions of solutions for light alloy testing.

15-12. **Scrap Salvaging Effects Saving.** Stephen Porter Lathrop. *Modern Machine Shop,* v. 19, June '46, p. 136, 138, 140, 142, 144, 146, 148, 150, 152.

An outline of the methods employed in the U. S. Naval Ordnance Plant at Chicago in the salvaging of scrap metals, oils, greases, rubber and paper.

15-13. **Saving Steel Scrap Segments.** *Steel,* v. 119, July 1, '46, p. 106-107.

Pressed steel department at Chrysler Corp.'s Dodge Division each week saves 300 tons of small pieces normally sold as scrap. To maintain production in spite of steel shortages, material is channeled into immediate use. Illustrations show how it is done.

15-14. **Composite Steel Salvage Reduces Product Cost.** John T. Smith. *Production Engineering & Management,* v. 18, July '46, p. 62-64.

Smart planning and the use of a flattening roll and resistance welding reduce scrap loss drastically and make possible effective utilization of sheet steel trimmings for nonstress members in the mass production of automotive vehicle bodies.

15-15. **How the Navy Salvages War Equipment.** R. G. Skerret. *Compressed Air Magazine,* v. 51, Aug. '46, p. 217-221.

Methods followed at the Maspeth, Long Island, Salvage Unit include degreasing, Magnaflux inspection, Kolene

process for deoxidizing in a molten salt bath, metal spraying and chromium plating of worn surfaces. A plastic dip is used to prepare parts for storage.

15-16. **Reclaiming Brass Scrap.** *Steel,* v. 119, Aug. 19, '46, p. 100.

As much as 42,000 lb. of brass borings and turnings are recovered daily by modern salvaging system.

15-17. **Handling Scrap in Small Aluminum Foundries.** J. M. La Cerra. *Aluminum and Magnesium,* v. 2, Aug. '46, p. 18-19.

Method whereby foundries will find a saving not only in the direct handling and melting of the scrap but also a great saving will be effected because foundry scrap will be reduced and a higher grade casting will be produced.

15-18. **Erie Railroad's Scrap Reclamation Project.** *Flow,* v. 1, Sept. '46, p. 38-41, 50-51.

Methods used at Meadville, Pa.

15-19. **Substitute Metallurgical Products.** Albert M. Portevin. (Translated from the French by William M. Baldwin, Jr.) *Metal Progress,* v. 50, Sept. '46, p. 485-494.

How serious wartime shortages of metals were combatted by French metallurgists. Manganese, silicon and carbon became the only alloying elements in engineering steels; cutting tools were welded-on nibs of toolsteels; aluminum was salvaged from airframes; zinc (relatively plentiful) replaced copper, brass and bronze in hardware; tin (salvaged) was confined to bearings and lean solders. Welding for salvage, repair and rebuilding assumed a major role in the mechanical economy.

15-20. **Secondary Aluminum.** *Metal Industry,* v. 69, Sept. 13, '46, p. 220-223.

Details taken from a report made by the Combined Intelligence Objectives Subcommittee investigating German industry.

15-21. **Thorium Reclamation Recovery From Gas-Mantle Residues.** A. G. Arend. *Chemical Age,* v. 55, Aug. 31, '46, p. 259-262.

Also the ore concentration and extraction processes. The reclamation is a wet chemical process.

15-22. **Worn Shafts.** S. Staton. *Iron and Steel,* v. 19, Sept. '46, p. 511-512.

Discusses equipment and actual operations involved in repair. Building up by metal spraying. Equipment; suitability of process for shafts; preparation of the surface—shotblasting, rough machining; application of metal.

15-23. **Eroded Steam Turbine Salvaged by Metallizing.** Henry M. Atwood. *Welding Engineer,* v. 31, Oct. '46, p. 52-53.

Stainless steel applied by metal spraying effectively checked the ravages of erosion on the housing of a steam turbine.

15-24. **Secondary Aluminum. (Concluded.)** *Metal Industry,* v. 69, Sept. 20, '46, p. 235-238.

Four main processes which had been evolved by the

Germans in connection with their methods of recovery of aircraft scrap.

15-25. **Distillation of Zinc and Refining of Residual Metals From Copper-Base Alloys.** Frank F. Poland. *Metals Technology,* v. 13, Sept. '46, T. P. 2065, 15 p.

Describes a new process for the refining of secondary copper-base metals and a specially designed high-temperature electric resistor furnace used for distillation of zinc from these metals. Process was used for conversion of nickel silver to cupronickel and to recover the zinc content in metallic form and for separating and reclaiming copper and zinc from scrap brass.

15-26. **Smelting and Refining Commercial Aluminum Ingot.** A. E. St. John. *Western Metals,* v. 4, Oct. '46, p. 56, 58-60.

"Commercial aluminum ingot" refers to aluminum alloys that are produced by the smelting and refining of salvaged metals to distinguish them from aluminum alloys made by the reduction of natural ores. Possibilities inherent in the use of this type of metal.

15-27. **Chevrolet Makes Parts Directly From Steel Chips.** *Machinery,* v. 53, Nov. '46, p. 184-187.

Chips used in this process are S.A.E. 1112 steel formed from torque-tube bushing operations on automatic screw machines. Chips are carefully segregated from other turnings to prevent contaminations; are placed in the perforated basket of a centrifugal chip wringer and rotated for 45 min. to remove oil from their surfaces. Dry chips then go to a shredding machine, where their size is reduced. Following shredding operation, the chips are screened, and those passing through the screen are used for forming the briquette.

15-28. **Metallizing Salvages Material and Cuts Maintenance.** *Coal Age,* v. 51, Nov. '46, p. 90-91.

Details of how process is applied by a coal mining and processing company.

15-29. **Scrap Recovery.** F. F. Poland. *Metal Industry,* v. 69, Nov. 29, '46, p. 448-450.

New process for the refining of secondary copper-base metals and a specially designed high-temperature electric resistor furnace used in the process for the distillation of zinc from these metals. Process was used for the conversion of nickel-silver to cupronickel and to recover the zinc content in metallic form. Also proved economical for reclaiming copper and zinc from scrap brass. (Paper presented to the A.I.M.E.)

15-30. **Salvaging and Reclaiming Scrap.** *Steel,* v. 119, Dec. 16, '46, p. 90, 142-145.

Worn-out equipment amounting to almost 50,000 tons annually yields important savings at railroad scrap reclamation plant.

15-31. **Reclamation of Aircraft Aluminum.** G. W. Birdsall. *Metal Progress,* v. 50, Dec. '46, p. 1232-1238.

Methods developed at Reynolds Louisville plant No. 5 have kept the costs well in line. Reclaimed metal is of such purity that no sweetening is required to make it suitable for use in wrought or cast products conforming to present-day specifications.

SECTION XVI

FURNACES AND FUELS

16-1. **Brass Cartridge Cases and Steel Mortar Shells Produced at Chase Euclid Case Plant, Part III.** *Industrial Heating,* v. 12, Dec. '45, pp. 2060-2062, 2064, 2066, 2068, 2070, 2072, 2088.

Gives ilustrated descriptions of furnaces used in many operations involved in the production of brass cartridge cases.

16-2. **New Information on Large and Small Gas Immersion Tubes, Part II.** William R. Teller. *Industrial Heating,* v. 12, Dec. '45, pp. 2090, 2092, 2094, 2096, 2098, 2100, 2102.

Small gas immersion tubes discussed.

16-3. **Spectroscopic Control of Side-Blow Converters.** *Industrial Heating,* v. 12, Dec. '45, pp. 2122, 2124.

Development of converter flame during the blow and appearance and disappearance of certain lines of the spectrum observed through the direct-vision spectroscope described. (Paper presented to the British Iron and Steel Institute.)

16-4. **Numerous Processing Ovens Used in Producing Pratt & Whitney Double Wasp Engines, III.** *Industrial Heating,* v. 12, Dec. '45, pp. 2143-2145.

Describes ovens for paint drying, drawing to relieve stress, and general purposes.

16-5. **Two-Section Gas-Fired Batch-Type Oven Used for Baking Cores.** *Industrial Heating,* v. 12, Dec. '45, pp. 2146-2147.

Gas-fired, two-section, batch-type oven completely eliminates rejects due to faulty baking, and saves considerable floor space.

16-6. **The Concentrated Combustion Burner.** J. Palser. *Gas Times,* v. 45, Nov. 24, '45, pp. 38-40, 41-45.

Describes certain developments in application of city gas to industrial heating processes based on lengthy experimental work in the Birmingham industrial laboratories.

16-7. **Operation of a 4-Ton Open-Hearth.** H. K. Work and W. R. Webb. *Iron and Steel,* v. 18, Nov. '45, pp. 503-506.

Experience gained during operation of an experimental open-hearth furnace summarized; typical charge discussed and modifications in original design described.

16-8. **Industrial Applications of the Non-Aerated Gas Flame.** J. F. Waight. *Gas Journal,* v. 246, Nov. 28, '45, pp. 765-768, 771.

Industrial applications of heat gas flames and burners; infra-red heating panels; baking ovens; melting furnaces; special furnaces; controls and performance.

16-9. **Three Blast Furnace Questions.** Owen R. Rice. *Blast Furnace & Steel Plant,* v. 33, Dec. '45, pp. 1523-1529.

Does easier driving reduce the coke rate per ton of pig? If so, how much? Do little furnaces have lower coke rates than big ones? Does a relatively large working volume conduce to lower coke rate? Answers suggested.

16-10. **Blowing Out of Blast Furnaces.** Otto Becker. *Blast Furnace & Steel Plant,* v. 33, Dec. '45, pp. 1530-1531.

Blowing out on a full furnace; steam requirements. (Paper presented at Joint Meeting of the Blast Furnace and Coke Oven Association of the Chicago District, and the Eastern States Blast Furnace and Coke Oven Association.)

16-11. **Use of Domestic Coke in Blowing a Blast Furnace.** William H. Burnett. *Blast Furnace & Steel Plant,* v. 33, Dec. '45, p. 1533.

Gives method and advantages. (Paper presented at Joint Meeting of the Blast Furnace and Coke Oven Association of the Chicago District and the Eastern States Blast Furnace and Coke Oven Association.)

16-12. **Blowing Out a Blast Furnace Utilizing the Nut Coke-Hydraulic Wash-Out Method.** J. R. Barnes. *Blast Furnace & Steel Plant,* v. 33, Dec. '45, pp. 1535-1536.

Gives methods and procedures used with various furnaces. (Paper presented at Joint Meeting of the Chicago District Blast Furnace and Coke Association and the Eastern States Blast Furnace and Coke Oven Association.)

16-13. **Various Methods Employed for Blowing Out Blast Furnaces.** W. H. Burnett. *Steel,* v. 118, Jan. 14, '46, pp. 109-110, 112, 115.

Domestic coke, blowout method; nut coke, hydraulic washout method; full furnace, blowdown method.

16-14. **A New Carbon Resistor Furnace.** W. J. Krolls, A. W. Schlechten and L. A. Yerkes. *Electrochemical Society Preprint* 89-2, 1946, p. 34-45.

An improved resistor furnace, which operates more satisfactorily for certain purposes than an induction furnace. It employs a slotted tube so that the current must go up one half and down the other. Both electric connections are at the bottom of the slotted tube. The electric resistance is almost four times that of a similar unslotted tube with top and bottom clamps. The new furnace operates at an estimated 38% efficiency.

16-15. **Ingot Heating With Modern Soaking Pits.** N. W. Richardson. *Iron and Steel Engineer,* v. 23, Jan. '46, p. 96-100.

Search for improved ingot heating has directed the attention of the steel industry to the developments of modern pit design. Emphasizes particularly the performance of the circular pit.

16-16. **Conservation of Fuels.** A. C. Pasini and C. R. Miller. *Iron and Steel Engineer,* v. 23, Jan. '46, p. 112-117.

Conservation of coal; conservation of fuel oil.

16-17. **Application of Tubes and Flues.** *Railway Mechanical Engineer,* v. 120, Jan. '46, p. 24-28.

New data on the advantages and disadvantages of copper ferrules; two methods of flue application presented.

16-18. **Brass Cartridge Cases and Steel Mortar Shells Produced at Chase Euclid Case Plant: IV.** *Industrial Heating,* v. 13, Jan. '46, p. 30, 32, 34, 36.

Illustrated descriptions of stress-relieving ovens and small arms case annealing furnaces used in processing brass cartridge case components.

16-19. **New Conveyor Design Increases Output of Aluminum Billet-Heating Furnace.** John H. Loux. *Industrial Heating,* v. 13, Jan. '46, p. 90.

Design of the conveyor, designated Rol-O-Veyor, is shown. Large-diameter tube extends through the furnace, supported at several points. This tube projects out onto the charging table in front of the furnace, and the end of the tube is connected to a gear-head motor. Alongside this tube are placed a series of idler rollers set in individual bearings and at an angle of approximately 45° to the tube.

16-20. **Heat Treating Plant of Triplex Corp. Features Use of Salt Bath Furnaces.** *Industrial Heating,* v. 13, Jan. '46, p. 168, 170, 172, 174.

Gas-fired heat treating furnaces; electric heat treating furnaces; quenching facilities; testing and inspection.

16-21. **Progress With Large Electric Steel Furnaces.** A. G. Arend. *British Steelmaker,* v. 12, Jan. '46, p. 34-37.

Features of reliable power consumption; hydraulic limitations and response to automatic control; self-baked electrodes and rapid charging; some recent improvements; developments contemplated.

16-22. **High Temperature Sand Testing.** D. C. Williams. *American Foundryman,* v. 9, Feb. '46, p. 55-59.

Brief description given of a newly constructed furnace for elevated temperature research on the hot compressive and hot transverse strength of foundry sand test specimens.

16-23. **The Outlook for an All-Basic Openhearth Furnace.** Robert B. Sosman. *Blast Furnace and Steel Plant,* v. 34, Feb. '46, p. 251-253.

Speed of production; life; chemistry of the slag; slag pocket cleaning; sensitivity to chemical attack; design.

16-24. **The "C.C." Burner.** J. Palser. *Gas Journal,* v. 247, Jan. 16, '46, p. 104-107.

A method of burning an air-gas mixture in a concentrated form, which has been applied to industrial heating processes. Burner consists of an air-blast burner arrangement which depends, in principle, upon the combustion of the gas mixture in a refractory tunnel to give a high temperature, high velocity, and a unidirectional stream

of products of combustion. Deals with the development of the burner from a practical point with some applications and results.

16-25. **Length of Pipe for Radiant Heating Coils.** *Heating and Ventilating,* v. 43, Feb. '46, p. 82.

Method for quick determination of the actual length of pipe in a sinuous coil radiant heating panel; useful in cost and weight estimation.

16-26. **Modern Arc Furnace.** W. N. Gittings. *Steel,* v, 118, March 4, '46, p. 146-148, 186, 188, 190, 192, 194.

Switchgear and control developments aid in successful operation.

16-27. **Some Characteristics of Blast Furnace Gas.** Owen R. Rice. *Iron and Steel Engineer,* v. 23, Feb. '46, p. 67-80.

Basic figures and relations used in making computations having to do with the production, condition, conduction and combustion of gas that comes from the coke-fired, pig-iron-producing blast furnace. Several refinements in blast furnace gas analysis which have a material effect upon accuracy of calculations.

16-28. **Composite Steel.** *Iron and Steel,* v. 19, Feb. '46, p. 57-60.

New 300-kw. high frequency furnace installation described.

16-29. **Rotary Hearth Furnaces.** *Iron and Steel,* v. 19, Feb. '46, p. 85-88.

Advantages for heat treatment or reheating work.

16-30. **Basic Arc Electric Furnaces.** *British Steelmaker,* v. 12, Feb. '46, p. 91-93.

Top charging vs. machine charging.

16-31. **Metal Finishing With Infra-Red Heat.** John Parina, Jr. *Steel,* v. 118, March 11, '46, p. 94-96, 138.

Ovens can dry prime and finish coats in 10 min. each; saving both time and floor space. Finish on smaller parts is dried in ovens suspended from ceiling.

16-32. **Heating up of Electric-Resistor Furnaces. Part I. The Two Phases of the Heating-up Process.** *Industrial Heating,* v. 13, Feb. '46, p. 250, 252, 254, 256, 258, 260.

Influences of the initial rate of energy input (connected load) and the wall design upon the heating-up time and power consumption of electric-resistor furnaces.

16-33. **Heat Treating and Galvanizing Performed in Commercial Metals Treating Co. Plants.** *Industrial Heating,* v. 13, Feb. '46, p. 323-324, 326, 328, 330, 332.

Furnaces in Plant Number 1 described.

16-34. **How Will You Choose Your Drying Oven?** Hubert Glatte. *Western Metals,* v. 4, Feb. '46, p. 23-27.

Drying and baking; distribution of heat; cost and efficiency of equipment; cost of operation; safety; quality of production; capacity of equipment.

16-35. **Furnace Equipment for Bright Hardening.** C. E. Peck. *Machinery,* v. 52, March '46, p. 178-180.

Principal types of industrial furnaces used in connection with bright hardening atmospheres.

16-36. High-Temperature Furnace for Distilling and Refining Metals. Frank F. Poland. *Materials and Methods,* v. 23, March '46, p. 710-712.

Developed to recover cupronickel from nickel silver, this furnace can be used to melt scrap of many nonferrous materials.

16-37. Arc Furnaces. Norman F. Dufty. *Iron and Steel,* v. 19, March '46, p. 91-96.

Design from the operator's standpoint.

16-38. Recent Improvements in Coke Oven Design and Operation. Louis N. Wilputte and Frans Wethly. *Blast Furnace and Steel Plant,* v. 34, March '46, p. 355-367.

Wilputte Coke Oven Corp. has adopted as standard 4 ft. 6 in. for the thickness of the brickwork over the top of the oven chamber. Offers also: mechanical loading of coal into the oven; entire elimination of coal spillage during charging; reduced leveling operations; smokeless charging; double compensating main for *(a)* the improvement in yields and quality of byproducts, and *(b)* elimination of carbon formation.

16-39. The Maintenance of Industrial Boiler Plant. G. H. Pearson. *Blast Furnace and Steel Plant,* v. 34, March '46, p. 386, 388-390.

Low boiler efficiencies due to admission of air greatly in excess of the quantity required to burn the fuel; inadequate combustion due to lack of facilities for the correct adjustment of dampers, and even absence of dampers, and incorrect control of forced and induced drafts; dirty boiler surfaces and flues; short-circuiting of the flue gases; high loss of heat from the outside surfaces of the plant; leakage of steam and hot water from valves and flange joints; incomplete burning of the fuel. Suggests remedies.

16-40. Recent Work of the Research Council of Alberta. Edgar Stanfield. *Canadian Mining and Metallurgical Bulletin,* no. 406, Feb. '46, p. 121-128.

A brief résumé of research programs with particular reference to the utilization of Alberta coals.

16-41. The Outlook for an All-Basic Openhearth Furnace. Robert B. Sosman. *Brick and Clay Record,* v. 108, Feb. '46, p. 56, 58.

Principal incentives for substituting a basic roof for the present silica roof on the openhearth furnace are: *(a)* increased speed for melting, *(b)* longer life of furnace, *(c)* less silica in slag, *(d)* easier cleanout of slag pockets. The principal disadvantages would be: *(a)* cost, and *(b)* weight.

16-42. New Carburizing Techniques Feature Operations at Canadian Acme Plant. Part II. *Industrial Heating,* v. 13, March '46, p. 424, 426, 428, 430, 460.

Casehardening furnaces.

16-43. A Study of Heating up of Electric-Resistor Furnaces. Part II. Victor Paschkis. *Industrial Heating,* v. 13, March '46, p. 434, 436, 438, 460.

Effect of individual variables; influence of connected

load, thermal conductivity, volumetric specific heat and wall thickness.

16-44. **Waste Heat Recovery.** E. C. Evans and A. H. Leckie. *Iron and Steel,* v. 19, March '46, p. 111-117.

Increasing efficiency in the iron and steel industry. (Paper for Institute of Fuel.) 21 ref.

16-45. **Beneficiation of Blast-Furnace Coke at the Kaiser Steel Co., Fontana, Calif.** J. Howard Thompson. *Blast Furnace and Steel Plant,* v. 34, March '46, p. 350-354.

With the use of Oklahoma low-volatile coal the blast-furnace coke yield increased rather noticeably; tar and light oil decreased. Although the volatile content of the Oklahoma coal is only about 17%, the yield of nitrogen from this coal is very high. With the adoption of this new coal blend, blast-furnace operation smoothed out. The beneficial changes were also accompanied by an increase in iron production and a noticeable drop in coke consumed per ton of hot metal produced.

16-46. **New Burner Type With Mechanical and Two-Stage Air Atomization With Flame Length Control for Open-hearth Furnaces.** S. S. Berman. *Engineers' Digest (American Edition),* v. 3, March '46, p. 126.

The fuel saving effected by the introduction of the new burner type was found to be some 6 to 7% with the 50-ton and 95-ton furnace, while it amounted to 15 to 26% with the 13-ton furnace. Burner operates at usual air or steam pressure of 4 to 5 atmospheres, attains high degree of oil atomization and flame stability with effective flame length control. (Abstract from *Stahl,* no. 9-10, 1944, p. 20-24.)

16-47. **Handling Equipment for Heat Treatment Furnaces.** H. D. Hendrick. *Machinery (London),* v. 68, March 14, '46, p. 329-333.

Charging machines for batch furnaces and handling equipment for continuous furnaces and shaker-type furnaces.

16-48. **The "Elkem" Rotating Arc Furnace for Electrothermic Process.** Tonnes Ellefsen. *Electrochemical Society Preprint* 89-12, p. 141-150.

The rotating arc furnace described has a number of advantages over the stationary type. Crater formation in the charge is eliminated; the electrodes more easily maintain their vertical position; operation is quiet and uniform. Typical installations are recorded. Furnaces of 6000 to 8000 kw. have been built and put into successful use. Among the products adapted to this furnace are ferro-alloys and calcium carbide. The rotating mechanism is presented in detail.

16-49. **Handling Equipment for Heat Treatment Furnaces.** H. D. Hendrick. *Machinery (London),* v. 68, March 21, '46, p. 367-371.

Design of chain and slat conveyers, pusher-type furnaces and quenching gear for batch and continuous operation.

16-50. **Automatic Pusher-Tray Furnace Programs Production and Improves Quality.** *Industrial Heating,* v. 13, April '46, p. 644, 646, 670.

Every 12 min. one tray containing its load enters the heating zone of the furnace and one casting is discharged, the total normalizing time being 48 min. in the heating zone, and 60 min. in the holding zone. Unique system coordinates a time clock with the complete actuating mechanism to raise furnace doors, discharge heated work, push in new charge and lower doors in accordance with a predetermined operating program.

16-51. **Multiple-Pass Continuous Baking Oven Used in Alloy Welding-Rod Production.** *Industrial Heating,* v. 13, April '46, 663-669.

Oven design, construction and operating features.

16-52. **Car-Type Furnaces.** *Steel,* v. 118, April 29, '46, p. 93.

Three car-bottom type stress-relieving furnaces serve Chicago Bridge & Iron in normalizing operations on massive pressure vessels and chemical plant equipment.

16-53. **Progress in Openhearth Furnace Construction and Operation.** *Blast Furnace and Steel Plant,* v. 34, April '46, p. 480-486.

Installation of monkey walls; reversing valves; water-cooled ports; automatic control; duplexing and triplexing; insulation.

16-54. **Waste Heat Recovery. II.** E. C. Evans and A. H. Leckie. *Iron and Steel,* v. 19, April '46, p. 161-164.

Discussion of paper on "Waste Heat Recovery" given to the Institute of Fuel by E. C. Evans and A. H. Leckie, together with authors' replies.

16-55. **Methods of Generating High-Frequency Electric Current for Induction Heating.** Harlan A. Messner. *Western Metals,* v. 4, April '46, p. 21-26.

Three predominant fields that present application for induction heating are surface hardening and heat treatment of metals, brazing, and heating for forging and upsetting. Use of induction heating will permit industry to approach its prewar production costs.

16-56. **Melting and Forging of Metals With Induction Heating.** J. Max Lee. *Western Metals,* v. 4, April '46, p. 29-30.

16-57. **Electrode Regulation for Modern Electric Furnaces.** A. G. Arend. *British Steelmaker,* v. 12, April '46, p. 184-187.

Precision regulation and hydraulic-electric control; diminished contact speed, voltages, and all-electric control; continuously supplied self-baked electrodes.

16-58. **Induced Heat Rolls up Its Sleeves.** R. M. Serota. *Machine Tool Blue Book,* v. 42, May '46, p. 145-160.

Latest developments in surface hardening, annealing, brazing, melting and preforging; typical jobs are described and data suggest other applications.

16-59. **Beneficiation of Blast Furnace Coke at the Kaiser Steel Co., Fontana, Calif. Part IV.** J. Howard Thompson. *Blast Furnace and Steel Plant,* v. 34, May '46, p. 584-586, 624.

Possible economics of low-temperature char process; oven dimensions and temperatures; comparison of Fontana char volatile vs. Colorado char volatile.

16-60. **Boiler House at the Perry Furnace Plant of Interlake Iron Corp.** Willis B. Clemmitt. *Blast Furnace and Steel Plant,* v. 34, May '46, p. 602-607.

Notable principally for its simplicity and practicality. Plant is equipped to burn four fuels.

16-61. **The Preparation of Coal and Coke for Coke Ovens and Blast Furnaces.** Charles L. Potter. *American Iron and Steel Institute Advance Copy,* May 23, '46, 29 p.

A complete system of sampling and testing of coal and coke through the various stages in the processes of blast furnace fuel manufacture is believed to be essential to the economic production of quality iron. Possibilities for beneficiation of otherwise undesirable raw material by a well-developed program of preparation are illustrated.

16-62. **Suppressing Gas Leaks on Blast Furnace Tops.** E. A. Anderson. *Steel,* v. 118, May 20, '46, p. 144, 147.

Recommends practices that serve to relieve adverse conditions.

16-63. **Rational Working of Furnaces for the Electrolysis of Aluminum.** L. Ferrand. *Engineers' Digest (American Edition),* v. 3, April '46, p. 171-173.

A general theory of the working of electrolysis of fused electrolytes is described, by which the measurement of efficiency is brought down to a final measurement of voltages, if certain conditions are fulfilled, so that checks can be made as often as desired. (Abstracted from *Journal du Four Electrique et des Industries Electrochimiques,* v. 54, no. 1, June '45, p. 10-13.)

16-64. **Arc Furnaces—Automatic Control Gear.** J. Lewis. *Iron and Steel,* v. 19, May '46, p. 183-185.

Requirements to be met in electric furnaces for steel melting and some of the methods for automatic control.

16-65. **Industrial Heat Treating Furnaces in Germany. Part I.** Cary H. Stevenson. *Industrial Heating,* v. 13, May '46, p. 762-764.

Findings of studies and questions involving the plants and personnel of 30 plants throughout Germany—both users and manufacturers of furnaces and furnace parts.

16-66. **Calculation of Salt-Bath Electrodes.** Victor Paschkis. *Industrial Heating,* v. 13, May '46, p. 784-794, 902.

Mathematical relationships existing between the numerous design factors for immersed-electrode type salt-bath furnace.

16-67. **The Outlook for an All-Basic Openhearth Furnace.** Robert B. Sosman. *Industrial Heating,* v. 13, May '46, p. 848-858.

Review of present status of the all-basic openhearth furnace, with a discussion of possible future trends.

16-68. **New Carbon Resistor Furnace.** W. J. Kroll, A. W. Schlechten, and L. A. Yerkes. *Metal Industry,* v. 68, May 10, '46, p. 363-364.

Report on improved carbon resistor furnace, which operates more efficiently for certain purposes than an induction furnace. Slotted carbon tube is used so that the current must go up one half and down the other, both electrical connections being at the bottom of the tube. (Paper for Electrochemical Society.)

16-69. **German Practice in Total Gasification.** B. M. Pearson. *Gas Times,* v. 47, April 27, '46, p. 33-38.

The double gas system; miscellaneous sources of gas additional to town gas manufacture; industrial lean gas producer systems; tar recovery.

16-70. **Fuel—Problems in the Swedish Iron and Steel Industry.** Magnus Tigerschiöld. *Iron and Steel,* v. 19, May 10, '46, p. 290-294.

Available resources; output analysis; provision of fuel during the war; fuel economy in Swedish blast furnaces; electric pig iron furnaces and sponge iron processes; open-hearth furnaces, gas producers and reheating furnaces; future prospects of the Swedish iron and steel industry.

16-71. **Fuel Efficiency—Problems in Connection With Specialized Processes.** C. Hulse and R. J. Sarjant. *Iron and Steel,* v. 19, May 10, '46, p. 295-301.

Problems discussed are: those dealing essentially with the fuel and the means taken for its efficient combustion; those relating to plant design and the mode of heat transference to the medium being heated; those mainly associated either with organization or with technique.

16-72. **Iron and Steel Works—Considerations of Some Problems in Fuel Utilization.** N. H. Turner and F. A. Gray. *Iron and Steel,* v. 19, May 10, '46, p. 302-308.

To make existing plants as efficient as possible and reduce fuel consumption to a minimum it is necssary to: utilize fully the byproduct gases; prevent loss of latent or sensible heat existing in the material produced after completion of the melting or heating process; cause the necessary heat transfer from the fuel into the material being processed to take place with as high a degree of thermal efficiency as possible.

16-73. **Air-Gas Ratio Control Applied to Nonatmospheric Pressure Furnaces.** H. C. McRae. *Transactions of the American Society of Mechanical Engineers,* v. 68, May '46, p. 385-390.

For reasons of economy and efficiency, in the burning of fuel gases in industrial furnaces it is essential to maintain the air-gas ratio at approximately the correct point for perfect combustion. Also to control the ratio of air flow to gas flow because of effect of burned gases or atmosphere upon material being heat treated. Discusses in detail the various control processes available, the equipment developed for the purpose, and analyzes the several control circuits, basing the work on the laws of low-pressure gas flow or noncompressible flow.

16-74. **Melting Light Alloys—Developments in Openhearth Furnaces.** H. Hocking. *Metal Industry,* v. 68, May 31, '46, p. 430.

Suggests technique that results in increasing efficiency

of melting process for light alloys; suitable modifications to openhearth furnaces for bulk outputs.

16-75. **Fuel Cost Economy at the Blast Furnace and Its Relation to Coal Selection and Preparation.** W. M. Bertholf. *Blast Furnace and Steel Plant,* v. 34, June '46, p. 727-732, 740.

Comparative evaluation of coals. Relationship between washed coal yield and ash content and fuel cost at the blast furnace.

16-76. **The "Hell-Hole" at Pacific Tube.** W. S. Colmery. *Western Metals,* v. 4, June '46, p. 32-33.

A gas-fired, production-line furnace for continuous heat treating of stainless steel.

16-77. **High-Temperature Metallurgical Furnace With Injector-Type Burners for Preheated Air and Gas of Low Heating Value.** K. M. Holzman and B. R. Imenitov. *Engineers' Digest (American Edition),* v. 3, May '46, p. 228-229.

In high-temperature reheating furnaces excellent results are obtained with injector-type burners in which the combustion air is introduced into the gas stream. In this connection the use of a gas of low calorific value is of special interest. (Abstract from *Stal,* no. 4, 1945, p. 124-126.)

16-78. **Basic Principles of Cupola Operation.** R. A. Clark. *Foundry,* v. 74, June '46, p. 102, 298-301.

Consistent and economical production of cupola iron of the desired quality requires consideration of coke properties, cupola lining contour, blast volume and quality of melting materials.

16-79. **Combustion Protective Controls.** D. A. Campbell. *Industrial Gas,* v. 24, June '46, p. 13-16, 30-33.

As combustion efficiencies improve and factory practices demand automatic ignition and control equipment, the necessity for protection against the hazards due to failure of any of this automatic equipment becomes more and more imperative.

16-80. **Immersion Heating Application.** S. F. Shepard. *Enamelist,* v. 23, June '46, p. 8-10, 58.

Immersion heating provides the most flexible means for the heating of many different liquids, since it is not only possible to control the combustion process, but also because sufficient heat transfer surfaces can be built into the unit to obtain the most desirable results.

16-81. **Calculating Coil and Burner Requirements for Gas-Fired Immersion Heating.** Robert M. Buck. *Iron Age,* v. 158, July 11, '46, p. 46-52.

Essential engineering data for calculating size of immersion coil and burner input required for gas-fired immersion heating of liquids. The information is applicable for pickling, plating, and rinsing, solvent cleaning, waxes, soft metal, heat treating salts, etc.

16-82. **The Pebble Heater—a New Heat-Tranfer Apparatus.** C. L. Norton, Jr. *Journal of the American Ceramic Society,* v. 29, July 1, '46, p. 187-193.

A new type of apparatus is capable of heating gases

above the operating temperatures permissible in metallic heat interchangers. Principle involved consists of heating refractory pellets by means of high-temperature gases and then passing a gas to be heated through a permeable bed of the heated pellets. Details of the refractory constructions are described and performance figures given for some operating units. Some applications for the use of this pebble heater in the ceramic and metallurgical fields given. One application is for preheating air for combustion, producing temperatures on a level with those of electric arc furnaces; another application is in the heating of reducing gases for reduction of metallic oxides.

16-83. **Byproduct Coking. Coking Industries in the Niagara Frontier.** Robert W. Pugh and Edward V. O'Neill. **Modern Coke Ovens, the Basis of a Chemical Industry.** Edward V. O'Neill. *Iron and Steel Engineer,* v. 23, June '46, p. 94-98, discussion p. 98-99.

Development and history of the industry in the Niagara frontier. The three present plants have a total of 13 batteries and 719 ovens. The second paper discusses the byproducts which make the process economical.

16-84. **Induction Heating.** J. Max Lee. *Iron and Steel,* v. 19, July '46, p. 437-440.

Principles and applications to the melting and forging of metals

16-85. **High Temperature Furnace.** F. F. Poland. *Metal Industry,* v 69, July 12, '46, p. 32-33.

Furnace developed to recover cupronickel from nickel silver, can be used to melt scrap of many nonferrous metals. Many new features are included in design.

16-86. **Gun Mounts and Ordnance Parts Fabricated and Heat Treated in Northern Pump Plant: Part III.** *Industrial Heating,* v. 8, July '46, p. 1108-1118.

Miscellaneous weld-shop furnaces, foundry melting furnaces and drying ovens; begins description of heat treating department.

16-87. **The Pebble Heater—A New Type of Refractory Heat-Transfer Apparatus.** *Industrial Heating,* v. 8, July '46, p. 1190-1196.

New apparatus is a moving-bed furnace capable of heating gases, such as air and steam, to temperatures above those obtainable in a metallic heater. Heated gas output is continuous, with nonfluctuating outlet temperatures.

16-88. **Mixed Fuels in Openhearth Furnaces.** J. C. Foster. *Iron and Steel Engineer,* v. 23, July '46, p. 88-91.

Marked reduction in plant fuel costs resulted from combination firing of openhearths with mixed coke oven and blast furnace gases and fuel oil.

16-89. **Waste Heat Recovery in the Metallurgical Industry.** E. C. Evans and A. H. Leckie. *Journal of the Institute of Fuel,* v. 19, June '46, p. 166-175; discussion p. 175-179.

The principal methods for the recovery of waste heat from the gases leaving the working space of the furnace may be roughly divided into four groups: Heating of the

incoming stock (in shaft or tunnel furnaces); preheating of the combustion gases in recuperators or regenerators; use in waste heat boilers; use in suitably designed gas turbines.

16-90. **How to Test Your Kiln for Sulphur.** M. J. Bozsin. *Brick & Clay Record,* v. 109, Aug. '46, p. 50, 52.

An iodometric method for determination of SO_2 in furnace atmospheres.

16-91. **The Care and Operation of Continuous Porcelain Enameling Furnaces.** Marvin Steele. *Enamelist,* v. 23, Aug. '46, p. 5-7, 52-53.

Types of fuel; operation of gas burners to light the furnace from a cold start; lighting oil-fired furnaces; to shut down furnace; miscellaneous notes; lubrication instructions; care during operation.

16-92. **Heat Treating Furnaces.** Victor Paschkis. *American Foundryman,* v. 10, Aug. '46, p. 81-87.

Furnace classification; basis of furnace selection; furnace temperatures; heating rate; furnace and storage space; cost comparison; rate of heat loss; furnace types compared; heating uniformity.

16-93. **Experiences With Balanced Air Feed in the Cupola. (Continued.)** T. H. Taft and H. A. Hallett. *Foundry Trade Journal,* v. 79, July 25, '46, p. 321-324.

Theory of operation; investigation of lining wear.

16-94. **The Ellipsoid Melting Furnace.** A. J. G. Smith. *Metallurgia,* v. 34, July '46, p. 153-154.

A modification of the horizontal rolling or rocking furnace which is mounted at an angle of 30°. Some typical melting performances.

16-95. **Hot-Blast Cupola Design.** E. Longden. *Iron Age,* v. 158, Aug. 29, '46, p. 44-50.

Review of the design features of some 11 types of European and American hot-blast cupola systems, together with a description of a unit proposed by the author. Operating characteristics of these designs are also considered briefly. (Abstract of paper for Institute of British Foundrymen.)

16-96. **Hot-Blast Cupola Design.** E. Longden. *Foundry Trade Journal,* v. 79, Aug. 15, '46, p. 387-395.

Hot-blast cupola designed by the author which awaits further development. Other hot-blast cupola systems. Application of preheated air to melt cast iron in the cupola type of furnace has been successful when basic and fundamental principles have been thoroughly recognized in the light of tonnage requirements and an improved control over the quality of the metal. (Paper for Institute of British Foundrymen.)

16-97. **Waste-Heat Boilers in the Metallurgical Industries.** J. A. Kilby and W. G. Cameron. *Journal of the Institute of Fuel,* v. 19, Aug. '46, p. 193-220.

Defines and illustrates the application of waste-heat boilers to the metallurgical industries, with particular reference to the iron and steel industry. Factors influencing

the installation of waste-heat boilers; sources of waste heat; design and layout; routine operations; the influence of waste-heat boilers on plant operation; economics of waste-heat boiler installations; typical waste-heat boiler installations; future developments. Results of efficiency tests on waste-heat boilers working on openhearth and on soaking furnace. 30 figures.

16-98. **Canada's First Straight-Through Continuous Enameling Furnace.** *Stove Builder,* v. 11, Sept. '46, p. 68, 70.

New enameling plant at Moffats Limited, Weston, Ont.

16-99. **Dividends From Furnace Draft.** Robert Reed. *Oil and Gas Journal,* v. 45, Sept. 14, '46, p. 80, 82-83.

Neglect of furnace draft and the details of furnace and burner operating details results in high furnace maintenance cost, fuel waste, danger of personnel injuries, and damage to process conditions. Shows in detail how a representative average furnace pressure indication may be had at all times when high winds prevail.

16-100. **Sulphur in Manufactured Gas—Its Effect Upon Dew Point of Flue Products.** William Buckley. *American Gas Association Monthly,* v. 28, Sept. '46, p. 403-406.

Sulphur trioxide in fuel gas raises the dew point considerably as well as producing an acid condensate. Both factors promote corrosion. Graphs show relationships of dew point, temperature, SO_2: SO_3 ratio, and H_2SO_4 content. Correlates the more important findings and suggests several factors for future investigation.

16-101. **The World's Largest Continuous Gas-Fired Enameling Furnace.** Fred A. Herr. *American Gas Journal,* v. 165, Sept. '46, p. 11-13, 50.

A full-muffle, U-type, 90 ft. long gas-fired continuous enameling furnace.

16-102. **Hot-Blast Cupola Design. (Continued.)** E. Longden. *Foundry Trade Journal,* v. 79, Aug. 22, '46, p. 421-432, 434.

Griffin, Longden, Dyer, Whiting, Acipco, and Piwowarsky hot-blast cupolas. Detail sketches of each type.

16-103. **Furnaces and Firing Procedure.** A. I. Andrews. *Finish,* v. 3, Oct. '46, p. 17-18, 56.

Box and continuous furnaces for enamel firing. Table gives production capacities of both.

16-104. **Dodge Bodies Baked by Direct-Fired Ovens.** Rupert Le Grand. *American Machinist,* v. 90, Sept. 26, '46, p. 117-121.

Products of combustion are mixed with recirculated air and blown at high velocity into zoned ovens. Air movement is greater than in indirect-fired ovens.

16-105. **Special Furnace Equipment Featured in Revere Copper & Brass Plant in Chicago.** *Industrial Heating,* v. 13, Sept. '46, p. 1424-1426, 1428, 1430, 1432, 1434, 1436, 1438-1439, 1446.

Flat annealing; cup annealing; other furnaces.

16-106. **Brazing and Heat Treating Assemblies for Magni-Lastic Expansion Joints: Part II.** *Industrial Heating,* v. 13, Sept. '46, p. 1456, 1458, 1460, 1462.

Electrically heated heat treating furnaces with integral quench station; a batch-type electric heat treating furnace; a box-type convection tempering furnace; a salt-pot tempering furnace.

16-107. **Stanley P. Rockwell Co. Plant Features Furnaces for High-Production Operation.** *Industrial Heating,* v. 13, Sept. '46, p. 1520, 1522, 1524, 1526.

Equipment in the production heat treating department described.

16-108. **Fuel Utilization in Steelworks.** *Coke and Smokeless-Fuel Age,* v. 8, Sept. '46, p. 204-206.

A study of fuel planning to secure optimum economy, based on papers presented to the Iron and Steel Institute and on a B.I.O.S. report on practice at a German steelworks.

16-109. **High-Frequency Furnace for the Production of High-Strength Cast Iron.** I. Forslund. *Engineers' Digest (American Edition),* v. 3, Sept. '46, p. 440.

Details of 5.5-ton furnace, including cross-sectional diagram. (Condensed from paper in *Gjuteriet,* v. 36, May '46, p. 74-81, 92.)

16-110. **Vertical Furnace for the Normalizing of Strip.** *Engineers' Digest (American Edition),* v. 3, Sept. '46, p. 446-448.

Furnace recently patented is under construction in France. Cross-sectional diagrams show details. It is designed for a temperature of 980° C. and for a throughput of 300 kg. per hr. of mild steel strip of 0.1 to 0.5 mm. thickness and 400 mm. maximum width. (Condensed from *Revue du Chaufage Electrique,* v. 14, March-April '46, p. 24-25.)

16-111. **Discussion of Comparative Fuel Costs for Crucible Melting Nonferrous Metals.** Davidlee Von Ludwig. *Industrial Gas,* v. 25, Oct. '46, p. 9-11, 24-25.

Details of experimental study on comparative costs of gas, oil, and solid fuels.

16-112. **Pressure Vessels Treated in Car-Type Stress-Relieving Furnace.** William Helme. *Industrial Heating,* v. 13, Oct. '46, p. 1606, 1608, 1610.

Furnace dimensions and construction; gas burners and control equipment; furnace capacity.

16-113. **Stanley P. Rockwell Co. Plant Features Furnaces for High-Production Operation. Part II.** *Industrial Heating,* v. 13, Oct. '46, p. 1676, 1678, 1680, 1682, 1684.

Convection-type tempering furnaces; pot-type salt-bath furnaces; induction heating equipment; miscellaneous production equipment; toolroom equipment.

16-114. **Problems in Fuel Efficiency.** C. Hulse and R. J. Sargent. *Blast Furnace and Steel Plant,* v. 34, Oct. '46, p. 1292-1294.

Present position of some of the problems relating to the efficient use of fuel in the iron and steel industry; possible solutions and lines of approach for future developments.

16-115. **Fuel Efficiency in the Brass Foundry Pays Dividends.** G. L. Harback and F. Hudson. *Foundry Trade Journal,* v. 80, Oct. 3, '46, p. 105-108.

Reviews the early work of the Association of Bronze and Brass Founders. Provides comparative data on coke and oil fuel melting, and gives examples of further economies which may be adopted more generally in the future.

16-116. **Beating the Coke Shortage.** *Foundry,* v. 74, Nov. '46, p. 77, 161, 164.

Repeats recommendations which have been made in the past for most efficient cupola operations.

16-117. **Fuels for Firing Porcelain Enamels.** A. I. Andrews. *Finish,* v. 3, Nov '46, p. 17-18, 25.

B.t.u. heat values of the different kinds of fuel; specifications for the different grades of fuel oils; analyses of different typical gaseous fuels; factors in the selection of fuel.

16-118. **Duplex Operation of Induction Heaters.** W. C. Rudd. *Electronics,* v. 19, Nov. '46, p. 93-95.

In the production of high-frequency power for induction heating, it has been found advantageous to use multiple unit oscillators for the production of powers beyond the capabilities of a single unit. Details of fundamental units; low reactance connection with coaxial cable; use of multiphase power lines; balancing the oscillator loads.

16-119. **Fuel Economy. Possibilities in the Fabrication of Nonferrous Metals.** Leslie Aitchison. *Metal Industry,* v. 69, Oct. 25, '46, p. 339-342.

Factors involved in nonferrous furnace practice, with emphasis on fuel economy.

16-120. **Conversion of Natural Gas to Liquid Fuels.** R. C. Alden. *Oil and Gas Journal,* v. 45, Nov. 9, '46, p. 79, 81-82, 97-98.

The Fischer-Tropsch process as developed in Germany for application to coal; American developments as applied to natural gas. Cost estimate shows U. S. process cost at 5 cents per gal. as compared with 8.8 cents for European process using natural gas and 19.2 cents using coal.

16-121. **Automatic Heat Treating Machine.** John R. Morrison. *Metal Progress,* v. 50, Nov. '46, p. 952-954.

Entire setup comprises two furnaces, separated by an oil quench tank and a washing machine. Over-all length is approximately 75 ft., each furnace having a hearth length of 16 ft. The hardening furnace has a maximum operating temperature of 1750° F.; the draw furnace, normally operated at 750 to 1100° F., is similar in design to the hardening furnace, and on occasion can be operated up to 1750° F.

16-122. **A Practical Furnace for Vacuum Melting.** A. U. Seybolt. *Metal Progress,* v. 50, Nov. '46, p. 1102-1106.

Furnace has proved very satisfactory for melting and casting 3½-lb. ingots of experimental high-nickel alloys, later processed into wire for radio tubes. Casting of 5-lb. or even 10-lb. ingots, depending upon density and melting

point, would be feasible in this equipment. The lowest pressure obtainable during operation is in the range of a few microns or better, and is a function of the character (volatility) of the charge.

16-123. **Duel-Fuel Heating Assures Continuous Porcelain Enameling.** Fred A. Herr. *Products Finishing,* v. 11, Nov. '46, p. 28-30, 32, 34, 36, 38, 40, 42.

Installation in Smoot-Holman's metal finishing and enameling departments.

16-124. **The Effects of Variations in Raw Materials on Basic Openhearth Operations and Production. Part II.** Charles R. FonDersmith. *Blast Furnace and Steel Plant,* v. 34, Nov. '46, p. 1393-1395.

Magnesia refractories, gaseous fuel, and construction materials.

16-125. **New Annealing Ovens Provide Various Economies.** Louis Belden. *Foundry,* v. 74, Dec. '46, p. 126.

Three innovations in annealing oven design at Canton Malleable Iron Co., Canton, Ohio.

16-126. **Fuel Economy.** Leslie Aitchison. *Metal Industry,* v. 69, Nov. 1, '46, p. 364-366.

Possibilities in the fabrication of nonferrous metals.

16-127. **Factors Affecting Furnace Electrode Selection.** T. L. Nelson. *Western Metals,* v. 4, Nov. '46, p. 24-26.

Extent of importance and variety of uses of carbon or graphite electrodes; costs and various steps in manufacture.

16-128. **Cupola Melts Above Rated Capacity.** Pat Dwyer. *Foundry,* v. 74, Dec. '46, p. 98-101, 233, 234.

Operation and construction of two cupolas of Forest City Foundries Co., Cleveland, which melt far above rated capacity.

16-129. **Fuel Utilization and Economy in the Refractories and Heavy Clay Industries.** E. Rowden. *Refractories Journal,* v. 22, Oct. '46, p. 321-333.

Fuel conservation in both intermittent and continuous kilns for firing the refractory materials and building materials.

16-130. **Arc Furnace Switching.** L. W. Long and J. F. Chipman. *Iron and Steel Engineer,* v. 23, Nov. '46, p. 53-59; discussion, p. 59-61.

Selection and maintenance of electric arc furnace switching devices; details of air blast interruption switches manufactured by Allis-Chalmers.

16-131. **Electric Steel Furnace Transformers.** A. G. Arend. *British Steelmaker,* v. 12, Nov. '46, p. 553-556.

Design and operation.

16-132. **Fuel Economy. (Concluded.)** Leslie Aitchison. *Metal Industry,* v. 69, Nov. 8, '46, p. 385-386.

Possibilities in the fabrication of nonferrous metals. Tables show power used in hot rolling, and in heating for rolling; fuel consumption in melting and fuel consumption in reheating.

16-133. **Some Factors Which Influence the Efficient Utilization of Fuel in Industrial Furnaces.** A. J. Thompson. *Gas Times,* v. 49, Nov. 9, '46, p. 124-126.

Effects of excess air, of insufficient air, of insulation, of heat recovery by recuperators and regenerators, on optimum production rates in metallurgical, ceramic, and other materials processing furnaces. Formulas, charts, and tables included.

16-134. **Port Design and Openhearth Flames—I, II, and III.** *Iron and Steel,* v. 19, Nov. 21, '46, p. 759-765.

Discussion of report on "Port Design and Open-Hearth Flames", by J. H. Chesters and M. W. Thring (see Item 27-172). Special instruments and technique; thermal conditions; general conclusions of report.

16-135. **Air-Fuel Ratio Controls Oil-Fired Soaking Pits.** L. E. Browne. *Steel,* v. 119, Dec. 23, '46, p. 68, 70.

Installation in which introduction of products of combustion blankets ingots with controlled neutral atmosphere. Heating is uniform, resulting in increased yields and decreased scaling.

SECTION XVII

REFRACTORIES AND FURNACE MATERIALS

17-1. Carbon Lining for Blast Furnace—Its History, Installation and Advantage. Frank J. Vosburgh. *Steel,* v. 117, Dec. 24, '45, pp. 86-88, 90.

Use of tamped carbon ramming mix was started in this country as an emergency. Hearths of English and German stacks laid up with this material were subject to cracking and breakouts. Salamanders seldom are encountered with carbon block linings. American furnacemen show keen interest in the use of carbon blocks.

17-2. Magnesium-Melting Pot Life Increased by Sprayed Special-Alloy Coating. A. V. Keller. *Industrial Heating,* v. 12, Dec. '45, pp. 2074, 2076, 2078, 2080.

Causes of short pot life; pot defects speed failure; coatting procedure; checking and recording performance; comparative-life data.

17-3. Carbon Products in the Steel Plant. *Industrial Heating,* v. 12, Dec. '45, pp. 2152, 2154, 2156.

Blast furnace hearth linings; impervious carbon or graphite; carbon-lined pickling tanks; graphite moldplugs and stools; miscellaneous uses. (Paper presented at meeting of the Association of Iron and Steel Engineers.)

17-5. Carbon Lining for Blast Furnace. Its History, Installation and Advantage. Frank J. Vosburgh. *Steel,* v. 117, Dec. 31, '45, pp. 62-63, 78, 80.

Shapes and sizes of carbon blocks for lining hearths and hearth walls of various stacks in this country and details of their installation presented. Operating reports of some European stacks with hearths lined with this material emphasize use of large blocks and careful laying up.

17-6. Basic Arc Furnaces. E. C. Brampton, H. Parnham and J. White. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 595-605; discussion, pp. 621-622.

Behavior of semi-stabilized dolomite linings.

17-7. Operating a 180-Ton Openhearth Furnace With Ends and Roof of Basic Construction. A. K. Moore. *Blast Furnace and Steel Plant,* v. 34, Jan. '46, p. 97-99.

General design, materials used and results obtained on a complete basic end construction on No. 16 openhearth

furnace, up to a life of approximately 400 heats. Comparison between all basic and silica furnace.

17-8. **Refractories Review for 1945.** Mervin A. Fay. *Blast Furnace and Steel Plant,* v. 34, Jan. '46, p. 105-107, 114.

Experimental and developmental programs carried on by both refractories producers and consumers.

17-9. **Refractories for Electric Melting in the Ferrous Foundry.** E. K. Pryor and L. R. Burke. *American Foundryman,* v. 9, Jan. '46, p. 55-60, 75.

Few simple precautions observed in electric furnace operation will prolong refractory life. Refractory failure; properties of silica; improved magnesite refractories; neutral refractories; composition equilibrium; temperature and load; refractory erosion; structural changes; masonry structure; fusion temperatures; direct-arc furnace; silica in roof construction; roof refractory properties; chrome-magnesite refractories; general refractory uses; high frequency induction furnace; rammed linings; mechanical strength; thermal shock; selecting refractories.

17-10. **Testing of Chrome Magnesite Brick for Resistance to Iron Oxide Bursting.** S. Zerfoss and H. M. Davis. *Journal of the American Ceramic Society,* v. 29, Jan. 1, '46, p. 15-20.

Probable mechanism of the iron oxide bursting of chrome-magnesite brick is discussed. An attempt was made to duplicate this effect in the laboratory. Results indicate that bursting can be simulated in a laboratory experiment providing the atmosphere of the furnace is such that penetrating iron oxide liquid is rich in magnetite. Test is proposed for characterizing bursting resistance of various brick.

17-11. **Refractories of the Future.** Raymond E. Birch. *Brick and Clay Record,* v. 107, Dec. '45, p. 57-59; *Ceramic Age,* v. 47, Jan. '46, p. 11-13.

The role that research and product development will play in bringing about better refractories performance.

17-12. **Use of Glazed Coatings to Protect Refractories.** Rexford Newcomb. *Industrial Heating,* v. 13, Jan. '46, p. 107, 110, 112, 114, 116.

Functions of glazed coatings which are adaptable to many types of high temperature equipment—boilers, incinerators, enameling furnaces, pottery kilns, gas generators, metal-melting furnaces and various types of steel treating equipment used for annealing, normalizing, tempering, carburizing, forging, and similar heat treating operations. Various temperature grades in which these refractory-coating materials are available.

17-13. **Basic Refractory Material in Openhearth Design and Maintenance.** *Industrial Heating,* v. 13, Jan. '46, p. 118, 120.

Summarizes value of basic brick in openhearth construction. (Discussed at recent meeting of the Pittsburgh Section of the National Openhearth Committee.)

17-14. **Progress in the Use of Refractories in 1945.** L. A. Smith. *Blast Furnace and Steel Plant,* v. 34, Feb. '46, p. 241-243.

Carburized nozzles; suspended silica roofs; refractory hangers; all-basic openhearth; super clay brick in blast furnace linings; refractory concrete; handling brick.

17-15. **Effect of Steelwork on Heat Loss Through Glass Tank Bottoms.** Harold T. Smyth. *Journal of the American Ceramic Society,* v. 29, Feb. 1, '46, p. 31-36.

Approximate mathematical method is worked out for determining effect of steel supporting members underneath a glass tank on heat loss from the glass tank and surface temperature of the refractories. Series of charts has also been prepared for the rapid calculation of heat loss and surface temperature, if the thickness and thermal conductivity of refractories and details of the steelwork are known.

17-16. **The Reduction of Silica by Liquid Steel.** W. Geller. *British Steelmaker,* v. 12, Feb. '46, p. 96-97.

Theory of the reactions between molten steel and a silica hearth, in particular the factors affecting the reduction of silica, are examined. Experiments are reported for 50 to 60-kg. melts in a 92% silica crucible heated in a coreless induction furnace in which white sand containing different amounts of carbon was put on the surface of the molten metal in three melts and glass slag was added in a fourth melt. (Abstract from *Archiv für das Eisenhüttenwesen,* v. 15, May '42, p. 479-490.)

17-17. **Use of Glazed Coatings to Protect Refractories. Part II.** Rexford Newcomb. *Industrial Heating,* v. 13, Feb. '46, p. 310, 312, 314, 316, 318.

Discussion of the chemical effects of slag; prevention of infiltration of air by coatings and their use as a bond; operating advantages of coated refractories.

17-18. **Making the Most of Insulation.** *Modern Industry,* v. 11, March 15, '46, p. 40-43.

New insulating materials give products better performance, increase salability; protect plants and processes. Check list tells what benefits you are getting from insulation and how many more you can get.

17-19. **Developments in Superduty Silica and High-Alumina Refractories.** *Industrial Heating,* v. 13, March '46, p. 496, 498.

Recent developments in superduty silica and high-alumina refractories. (Discussed before Pittsburgh Section of American Ceramic Society.)

17-20. **Southwestern Section of Openhearth Conference Reviews Operating Problems. Part I. Refractories Maintenance.** *Industrial Heating,* v. 13, March '46, p. 500, 502.

Bottom and taphole repairs; roof life and maintenance.

17-21. **The Influence of an Interior Coating of Aluminum Paper on Internal Thermal Conditions and Heat Economy.** R. J. Lorenzi, L. P. Herrington and C. E. A. Winslow. *Heating, Piping & Air Conditioning,* v. 18, April '46, p. 109-114.

Lining of reflective insulation (aluminum foil on kraft paper) applied to walls and ceiling of a brick-walled test room reduced the radiant heat transfer to the surfaces

with consequent lowering of inside wall surface 4 to 5° below the corresponding temperatures of brick walls. The response to heating and cooling was more rapid, there was a reduction in the over-all coefficient of heat transfer and a saving of 20% in heat required to maintain comparable room conditions. Night cooling during 8 hr., permitting room temperature to fall to 50° F., effected a saving of 33% of the heat required to maintain 70° F. continuously in the absence of aluminum.

17-22. **Openhearth Bottom Repairs.** J. B. McIntyre. *Iron Age,* v. 157, May 23, '46, p. 62-64.

Mechanical device, developed in England, for extracting liquid metal from openhearth bottom cavities preparatory to patching. Designed as an accessory for mechanical charging units, it employs vacuum to lift metal to a refractory-lined container. Comments upon a machine used in Britain for applying dolomite or magnesite to bottom cavities.

17-23. **Furnace Roofs—the Outlook for an All-Basic Openhearth.** Robert B. Sosman. *Iron and Steel,* v. 19, May '46, p. 205-206.

Possibilities of a changeover to basic roofs are discussed in detail. (Paper for American Institute of Mining and Metallurgical Engineers.)

17-24. **Dolomite Linings for Basic Electric Arc Furnaces.** E. C. Brampton, H. Parnham, and J. White. *Refractories Journal,* v. 22, April '46, p. 112-121.

Severe operating condition in this service; analysis of gases and fumes. X-ray data given on constituents present in lining after service tests. (Paper for British Iron and Steel Institute.)

17-25. **Carbon Products in the Steel Plant.** Frank Vosburgh. *Iron and Steel Engineer,* v. 23, May '46, p. 60-67, 78.

Use of carbon instead of ceramic linings in blast furnaces and in other steel mill applications has many possibilities. Some recent applications described.

17-26. **Some Special Refractories and Their Industrial Application. Part III—Where They Are Used.** W. H. Henson and C. W. Henson. *Brick & Clay Record,* v. 108, June '46, p. 48-51.

In processing many metals special refractories are required to produce metal of high purity, give maximum operating economy by high thermal conductivity, and resist penetration of metal or oxides. Retorts, crucibles, tubes for recuperators and furnaces, slag-hole blocks, laboratory ware.

17-27. **Carbon Refractories.** *Refractories Journal,* v. 22, May '46, p. 147-151.

Properties and manufacture of Carblox, carbon refractories, for blast furnace hearths.

17-28. **Dolomite Linings for Basic Electric Arc Furnaces.** E. C. Brampton, H. Parnham, and F. White. *Refractories Journal,* v. 22, May '46, p. 152-159.

Detailed description of furnace construction and recommendations for using dolomite brick.

17-29. **Behavior of Various Types of Openhearth Bottoms.** R. B. Snow. *Steel,* v. 119, July 22, '46, p. 112, 115.

Sintered-in double-burned dolomite hearth or sintered-in bottom with little silica, high magnesia and free of lime affords improved practice. Use of chrome brick beneath working surface recommended because of nonhydrating property. Optimum performance obtained when sintered magnesite surface is 50% of total hearth thickness.

17-30. **Cupola Refractories.** E. J. Lally. *American Foundryman,* v. 10, July '46, p. 47-48.

Proper selection of methods and materials for cupola lining and patching.

17-31. **Dolomite Linings for Basic Electric Arc Furnaces. (Continued.)** E. C. Brampton, H. Parnham, and F. White. *Refractories Journal,* v. 22, June '46, p. 186-199.

Chemical and physical properties and comparison with other materials. (Paper for autumn 1945 meeting of the Iron and Steel Institute.)

17-32. **Physical Properties of Some High-Temperature Refractory Compositions.** Gordon R. Pole, Alfred W. Beinlich, Jr., and Nathan Gilbert. *Journal of the American Ceramic Society,* v. 29, Aug. 1, '46, p. 208-222.

Use of a regenerator packed with relatively fine refractory material for heating gases results in more efficient heat exchange than can be realized in a conventional heat exchanger; practical application of the process was found to depend on the availability of a suitable refractory for furnace linings; small-scale tests disclosed a number of compositions which show promise as high-temperature refractories, but full evaluation for use on a large scale was not made. 27 ref.

17-33. **Steel Foundry Refractories.** J. L. Harrison. *Metal Treatment,* v. 13, Summer '46, p. 95-98.

Discusses problems in connection with converter steel plant. The cupola; possible sulphur pickup from ganister in the cupola; desulphurizing ladles; basic ladles; converter linings; sand additions; enlargement of tuyeres and casting-pit refractories. 11 ref.

17-34. **News Gleanings for the Refractories Industry.** L. Sanderson. *Refractories Journal,* v. 22, July '46, p. 226-229.

A review of new developments.

17-35. **Dolomite Linings for Basic Electric Arc Furnaces. (Concluded.)** E. C. Brampton, H. Parnham and F. White. *Refractories Journal,* v. 22, July '46, p. 238-244.

Results of investigations of analysis and structure of the various zones in used refractories are presented. Includes sulphur pickup by bricks in basic electric furnaces, atmospheric conditions in the electric furnace and mechanism of flux transfer.

17-36. **New Mineral Wool Insulation Standard.** *Steel,* v. 119, Sept. 2, '46, p. 120, 122.

Tests described cover all material of fibrous form processed from molten rock, slag or glass. Forms of industrial mineral wool for which test methods are given are blanket, block, board, felt, granulated, industrial batt, insulat-

ing cement, loose, and pipe insulation of both blanket and molded forms. Uniform and detailed methods of testing and recording physical and chemical properties are given.

17-37. **Spalling of Silica Bricks.** T. W. Howie. *Transactions of the British Ceramic Society,* v. 45, Feb. '46, p. 45-61; discussion p. 61-69.

Low-temperature spalling of silica bricks is studied. Amount of spalling is dependent on heating rate. Effects of dampness and of soaking in creosote were evaluated. Experimental technique detailed.

17-38. **An Investigation Into the Properties of Silica Bricks.** G. R. Rigby, R. P. White, H. Booth, and A. T. Green. *Transactions of the British Ceramic Society,* v. 45, Feb. '46, p. 69-105; discussion p. 105-109.

Modulus of elasticity, structure and spalling resistance of 19 silica bricks and two siliceous bricks were investigated. Method of determining the proportions of glass, quartz, tridymite, and cristobalite in silica bricks is described. Phase conversions with temperature are evaluated and performance results of certain brands in open-hearth roofs are given. 38 ref.

17-39. **Refractories for Ovens, Furnaces, and Boilers—I.** *Coke and Smokeless Fuel Age,* v. 8, Aug. '46, p. 166-168.

Characteristics of refractory materials, their methods of manufacture and their suitability for various high-temperature purposes are outlined. This installment covers firebrick and silica bricks. Includes analyses of typical refractory materials.

17-40. **Behavior of Different Types of Openhearth Bottoms in Service.** R. B. Snow. *Brick & Clay Record,* v. 109, Sept. '46, p. 73-74.

Service results are described. Recommends either a sintered-in double-burned dolomite bottom or a sintered-in bottom containing extremely little silica and relatively high magnesia but no free lime.

17-41. **Electric Shop Practices.** H. R. Larson. *Iron and Steel Engineer,* v. 23, Sept. '46, p. 120-124; discussion p. 124-128.

Silicone varnishes, combined or used as a bond with glass fiber, mica, or asbestos, now produce an insulation which may be continuously operated at temperatures up to 175° C.

17-42. **Rammed Refractories in Electric Furnaces.** Robert H. Zoller. *Refractories Journal,* v. 22, Aug. '46, p. 255-260.

Selecting a refractory for the job; developing routine methods for refractory installation and preparing the unit for service; drying and preheating are important factors in lengthening refractory life and decreasing foundry operating costs. (Paper presented at American Foundrymen's Association, May 1946.)

17-43. **Aluminum Blast Furnace Tuyeres.** *Iron Age,* v. 158, Oct. 10, '46, p. 68-70.

Experimental studies conducted in Japan, Germany, England and France since 1920, on the use of aluminum

tuyeres in blast furnace practice. Comparative data between copper and aluminum tuyeres, and the method of producing cast aluminum tuyeres.

17-44. **The Behavior of Refractory Materials Under Stress at High Temperatures.** F. H. Clews, H. M. Richardson, and A. T. Green. *Transactions of the British Ceramic Society,* v. 45, May '46, p. 161-176.

Deformation under compressive stress of three types of fireclay fired at 1400 and in some cases at 1500° C. has been observed at temperatures of 1250, 1350, and 1400° C. In each experiment the rate of deformation is rapid at first but the rate decreases with lapse of time tending to become linear at the higher temperatures and pressures of testing. An explanation of the behavior has been sought in the conception of a yield value.

17-45. **Openhearth Repairs and Maintenance. Part II.** *Industrial Heating,* v. 13, Sept. '46, p. 1510, 1512, 1514.

Rammed vs. burned-in bottoms and inverted-arch bottoms.

17-46. **Refractories for Ovens, Furnaces and Boilers. Part II.** *Coke and Smokeless-Fuel Age,* v. 8, Sept. '46, p. 196-199, 203.

Characteristics of refractory materials, their methods of manufacture and their suitability for various high-temperature purposes. (To be continued.)

17-47. **The Manufacture of High-Temperature Refractories and Ceramics in Germany.** *Refractories Journal,* v. 22, Sept. '46, p. 289-297.

Visits to four German plants. First report describes experimental work which had been done on ceramics for gas turbine blades; the others describe operations at refractories plants. (Reprinted from the British Intelligence Objectives Sub-Committee's Final Report No. 465, items 21 and 22.)

17-48. **Cupola Refractories.** E. F. Lally. *Refractories Journal,* v. 22, Sept. '46, p. 298-300.

Proper selection of methods and materials for cupola lining and patching. (Presented at Refractories Session of Fiftieth Annual Meeting, American Foundrymen's Association.)

17-49. **Abstract of Annual Report of American Refractories Institute Fellowship.** Stuart M. Phelps. *Blast Furnace and Steel Plant,* v. 34, Oct. '46, p. 1316, 1319-1320.

Use of hot load test as one means of evaluating the refractoriness of silica brick; measurement of temperature of panels during spalling by means of a radiation pyrometer sighted on the surface of the test brick; development of an oxygen-gas injector for the portable P. C. E. furnace; improvements in dial-type brick-measuring device for obtaining the dimensions for insulating firebrick; more satisfactory permanent liner change test; development of a more satisfactory dry air-set mortar, making use of dry sodium silicate.

17-50. **Gas and Air Port Blocks.** J. R. Rait. *Iron and Steel,* v. 19, Oct. '46, p. 543-550.

Limitations of siliceous jointing cements frequently used

in gas and air port construction. Modern trends of thought regarding revolutionary furnace design and new types of super quality refractories are outlined. New method developed by William Jessop & Sons, Ltd., for the construction of gas and air port blocks in acid openhearth furnaces eliminates failures due to the fluxing of siliceous jointing material and facilitates hot repairs.

17-51. **The Reversible Thermal Expansion and Other Properties of Some Magnesian Ferrous Silicates.** G. R. Rigby, G. H. B. Lovell, and A. T. Green. *Transactions of the British Ceramic Society,* v. 45, June '46, p. 237-250.

A number of compositions in the ternary system MgO-FeO-SiO_2 and two compositions in the quaternary system CaO-MgO-FeO-SiO_2 have been synthesized. These compositions are to be found in the orthosilicate solid solution series, clinoenstatite-FeO-SiO_2. The specimens have been examined in thin section and the optical properties are described.

17-52. **Electrodes—Carbon and Graphite Acid Electric Practice.** T. L. Nelson. *American Foundryman,* v. 10, Oct. '46, p. 40-48.

Methods of manufacture, mixing ingredients, properties, factors in favor of large and of small diameter electrodes, carbon vs. graphite, consumption rates, and precautions in handling and installation technique, as related to acid electric practice.

17-53. **Refractories for Ovens, Furnaces and Boilers—III.** *Coke and Smokeless-Fuel Age,* v. 8, Oct. '46, p. 216-217, 229.

The characteristics of refractory materials, their methods of manufacture and their suitability for various high-temperature purposes. This installment covers bonding cements; bauxite, chrome, spinel, and carbon bricks; graphite; Carborundum; zircon and zirconia. Factors to be considered in selection of refractories.

17-54. **The Durability of Refractory Materials in the Carbonizing Industry.** E. Heaton and A. T. Green. *Journal of the Institute of Fuel,* v. 20, Oct. '46, p. 27-34; discussion p. 34, 44.

Materials construction, mechanism of slag erosion, and the general behavior of refractory materials when exposed to attack by alkali vapor at various temperatures. Classifies, in general way, the failures which occur in the three main types of carbonizing plant, vertical retorts and coke ovens. 23 ref.

17-55. **Comments on the German Refractories Industry as Investigated in 1945.** Stuart M. Phelps. *American Refractories Institute Technical Bulletin* no. 84, Oct. '46, 11 p.

The manufacturing methods used and also the methods of application in the iron and steel industry are described. Drawings show some design details, such as construction of an openhearth roof.

17-56. **German Refractory Materials.** Alfred B. S. Searle. *Refractories Journal,* v. 22, Oct. '46, p. 334-336.

Great care and skill with much attention to detail are exercised in the German works, but little really noteworthy in manufacturing technique or equipment was

encountered. (Summary of reports issued by the British Intelligence Objectives Sub-Committee.)

17-57. **Rammed Refractories in Electric Furnaces.** Robert H. Zoller. *American Foundryman,* v. 10, Nov. '46, p. 67-69; discussion, p. 69-70.

Selecting a refractory for the job; developing routine methods for refractory installation and preparing the unit for service. Drying and preheating are important factors in lengthening refractory life and decreasing foundry operating costs.

17-58. **Toward Longer-Lived Abrasives.** L. E. Browne. *Steel,* v. 119, Dec. 2, '46, p. 104-105, 142, 144, 146.

New development whereby final grain is produced for first time in electric furnace, obviating crushing and milling. Highly irregular plane surfaces retained in wheel face after bonding greatly increase cutting efficiency.

17-59. **The Action of Carbon Monoxide on Refractory Materials. Part VII. Some Aspects of the Catalytic Action of the Ferruginous Glass of Iron Spots.** F. H. Clews, F. Ball, and A. T. Green. *Transactions of the British Ceramic Society,* v. 45, July '46, p. 251-255.

Samples of a ferrous alumino-silicate glass were prepared by heating metallic iron on a firebrick at 1350° C. Glass was ground and passed over a magnet to remove particles of magnetite or metallic iron. Its behavior toward carbon monoxide at 450° C. was examined directly, after heating in carbon monoxide or hydrogen at 900° C., and after heating in oxygen at 900° C. The glass was almost inert when exposed directly to carbon monoxide at 450° C. but reacted when exposed to the other treatments. Results are used to explain the behavior of firebricks in service on the assumption that after a hard kiln firing the constitution of the iron spots resembles that of the glass used in the experiments. (Reprinted from *Bulletin of the British Refractories Research Association,* no. 68, Feb. '45.)

17-60. **The Behavior of Refractory Materials Under Stress at High Temperatures. Part V.** F. H. Clews, H. M. Richardson and A. T. Green. *Transactions of the British Ceramic Society,* v. 45, July '46, p. 255-268.

Reviews previous papers of this series on behavior of porcelain and fireclay in torsion at 900 to 1100° C. Nonrecoverable deformation is shown not to be of a simple viscous character in that the rate is not proportional to the stress. From experiments on fireclay and porcelain materials in compression at 1250 to 1400° C. it is evident that the rate of deformation increasingly accelerates as the load is increased. 14 ref. (Reprinted from *Bulletin of the British Refractories Research Association,* no. 68, Feb. '45.)

17-61. **Gas and Air Port Blocks.** J. R. Rait. *Iron and Steel,* v. 19, Nov. '46, p. 587-589, 616.

New technique for the construction of this type of gas and air port block using special, large, rectangular silica bricks undercut to give the correct pitch of port, in place of arches in the gas and air ports, provides horizontal foundations for the brickwork on top. Gas and air ports

thus constructed have had greater mechanical stability in service and longer life. Hot repairs to the gas and air port blocks are carried out with much greater ease and speed than with arched ports, because centers are not required and the bricklaying is greatly simplified.

17-62. **Obtaining Caustic Magnesite From Electric Furnace Slag.** A. M. Kuznetzov. *Journal of Applied Chemistry* (U.S.S.R.), v. 19, no. 4, '46, p. 385-390. (In Russian.)

Investigation resulted in the establishment of optimum operating conditions and temperatures for the calcination of electric furnace slags. These slags are a new source of raw material suitable for the production of magnesite cement.

SECTION XVIII

HEAT TREATMENT

18-1. **Theory of Induction and Dielectric Heating.** *Industrial Heating,* v. 12, Dec. '45, pp. 2104, 2106.

Salient points brought out in the presentation of paper before Pittsburgh section of the American Institute of Electrical Engineers and the electrical section of the Engineers' Society of Western Pennsylvania.

18-2. **Temper Brittleness in Medium Carbon Steels.** *Industrial Heating,* v. 12, Dec. '45, pp. 2112, 2114.

Review of paper presented before Pittsburgh Chapter of American Society for Metals.

18-3. **Metallurgical Characteristics of Induction Hardened Steel.** *Industrial Heating,* v. 12, Dec. '45, p. 2116.

Specimens of 4340 steel heat treated by induced high frequency (355,000 cycles) electric current and quenched were found to have same metallurgical characteristics as furnace-heated and quenched specimens. (Paper read by James W. Poynter at meeting of Pittsburgh Chapter ASM.)

18-4. **The Scaling Properties of Steels.** *Industrial Heating,* v. 12, Dec. '45, pp. 2118, 2120.

Scaling characteristics of a selection of steels in furnace atmospheres at 2102° F. (Paper for British Iron and Steel Institute.)

18-5. **Kalamazoo Steel Process Company Features Variety of Equipment.** *Industrial Heating,* v. 12, Dec. '45, pp. 2170, 2172, 2174, 2176, 2178, 2180-2182, 2201.

Furnace equipment; drawing equipment; carburizing equipment; inspection.

18-6. **The Training of Heaters.** L. T. Pearsall and J. L. McHugh. *Iron & Steel Engineer,* v. 22, Nov. '45, pp 59-63.

Despite the many improvements in automatic controls on continuous furnaces, quality heating is still largely dependent on the skill and experience of the heater.

18-7. **Some Applications of Sub-Zero Treatment of Steel.** *Machinery (London),* v. 67, Nov. 22, '45, pp. 580-581.

Specific examples that indicate what can be accomplished by cold treatment of steel for tools and other purposes.

18-8. **Surface Hardening.** G. Seulen and H. Voss. *Iron & Steel,* v. 18, Oct. '45, pp. 445-453, 466.

Electrotechnical fundamentals and commercial possibilities of various methods of surface hardening of heat treatable steels outlined and the temperature gradients and hardness depths discussed. Results obtained with various heat treatable steels given. 8 ref. (From *Stahl und Eisen,* Dec. 23 and 30, '43.)

18-9. **Pearlitic M.C.I.** R. W. Lindsay and J. E. Atherton. *Iron and Steel,* v. 18, Nov. '45, pp. 519-522.

Isothermal transformation at sub-critical temperatures shows that the material reacts to heat treament in a similar way to steel.

18-10. **Induction Heating Can Make Money on a Job-Shop Basis.** *American Machinist,* v. 89, Dec. 20, '45, pp. 130-133.

How plants with flexible equipment can do induction heating work for others on short-run or experimental basis.

18-11. **Heat Treatment of High Speed Steel Cutters.** *Tool & Die Journal,* v. 11, Dec. '45, pp. 84-85, 96

Modern controlled atmosphere furnaces harden tools uniformly without carburization, decarburization or scale.

18-12. **The Basic Flame Hardening Setups.** *Industry & Welding,* v. 18, Dec. '45, pp. 39-41, 66-69.

Illustrates and describes a number of simple setups small shops have found useful for small-lot flame hardening.

18-13. **Welding and Annealing Stainless Steels, II.** H. C. Esgar. *Western Metals,* v. 3, Dec. '45, pp. 27-29.

Discusses chromium-nickel (austenitic), straight chromium (ferritic) and straight chromium (martensitic) stainless steels. Recommends use of muffle or semi-muffle type furnaces with accurate pyrometric control, maintaining a neutral atmosphere.

18-14. **Structural Changes.** G. V. Smith, R. F. Miller and C. O. Tarr. *Western Metals,* v. 3, Dec. '45, pp. 31-33.

Samples comprised three carbon steels of similar composition but deoxidized differently, and six molybdenum steels (0.1 to 0.2 % C, 0.5% Mo) similar except for silicon content and mode of deoxidation, tempered for periods ranging up to 5000 hours at 900, 1000, or 1100° F.; observations made of hardness (measured at ordinary temperature) and microstructure, particularly with respect to progress of spheroidization and possible occurrence of graphite. Each was tested in two initial conditions, annealed and normalized. Results given.

18-15. **Degassing.** *Metal Industry,* v. 67, Dec. 21, '45, pp. 421.

Process as applied to solid metals. 2 ref.

18-16. **Precise Control of Steel Hardening.** H. A. Knight. *Materials & Methods,* v. 22, Dec. '45, pp. 1736-1738.

Complete control in hardening SAE 4150 steel increased output, reduced costs and virtually overcame heat treating rejections.

18-17. **Induction Heating Constants.** *Materials & Methods,* v. 22, Dec. '45, p. 1783.

Physical constants of metals.

18-18. **Seamless Steel Tubes—II.** H. Sanders. *British Steelmaker,* v. 11, Dec. '45, pp. 557-561.

Discusses heat treatment of seamless steel tubes.

18-19. **The Heat Treatment of Low Alloy Wrought Steels.** *Metallurgia,* v. 33, Dec. '45, pp. 73-78.

Considers carefully entire problem of heat treatment to insure that the best possible results should be obtained from steels.

18-20. **High Frequency Hardening Improves Product Quality.** H. K. Branson. *Production Engineering & Management,* v. 17, Jan. '46, pp. 90-92.

Production time has been reduced and operation costs lowered at Douglas Aircraft Co. by the application of high frequency heating to case hardening and multiple brazing operations.

18-21. **Heat Flow in the Jominy End-Quench Hardenability Test.** Yu-lin Yao. *Journal of the Chinese Institute of Engineers, American Section,* v. 3, Nov. '45, pp. 195-198.

A mathematical equation is set for the Jominy end-quench hardenability test and its formal solution is given.

18-22. **Effect of Cooling Transformation Upon Subsequent Isothermal Reactions.** C. A. Liedholm and W. C. Coons. *Metal Progress,* v. 49, Jan. '46, pp. 104-107.

Isothermally quenched microspecimens of S.A.E. 4330 steel transformed completely to bainite at 600° F. in 30 min. and at 700° F. in 60 min., but weldments and microspecimens (½-in. cubes) which were cooled slowly to 600 or to 700° F. and held up to 6 and 12 hr., respectively, were but partially transformed. The slow cooled, isothermally transformed steel showed a large proportion of pro-eutectoid ferrite, not found in the specimens which were quenched to the isotherm. 8 ref.

18-23. **Effect of Heat Treatment on the Endurance Limit of Alloyed Gray Cast Iron.** T. E. Eagan. *American Foundryman,* v. 8, Dec. '45, p. 44-53.

Effect of size of section and original microstructure on final heat treated tensile strength and endurance limit. Heat treatment to obtain high tensile strength does not give a proportionate increase in endurance limit. Original as-cast structure has a profound influence on the endurance limit obtained after heat treatment. 4 ref.

18-24. **Local Heating in Plain Carbon Steels.** W. J. Wrazej. *Iron and Steel Institute Advance Copy,* Nov. '45, 5 p.

Examination of certain samples of steel, parts of which had been subjected to various types of local heating, notably from the blast of hot gases and by friction. 8 ref.

18-25. **Nitriding for Longer Tool Life.** George T. Long. *Tool and Die Journal,* v. 11, Jan. '46, p. 87.

Nitriding bath has a melting point of approximately 900° F., a range of 950 to 1200° F., and is generally operated at about 1025 to 1050° F. For unusually fragile tools an operating temperature of 950 to 1000° F. is preferable. Treating time will vary from 10 to 90 min., and will be governed by the size, shape and ultimate use of the tool and by the operating temperature. Case depth will vary,

of course, in relation to the period of immersion. Savings achieved far in excess of relatively small cost involved.

18-26. **Induction Hardening as Applied to Farm Machinery.** F. F. Vaughn. *S.A.E. Journal,* v. 54, Jan. '46, p. 38-44.

Some of the problems involved in using high frequency current. Examples of typical tractor and engine parts that are being successfully induction hardened in production.

18-27. **Induction Heating.** N. R. Stansel. *Iron and Steel Engineer,* v. 23, Jan. '46, p. 102-111.

Induction heating has vast possibilities because of its properties of applying heat in the local area where it is desired, and because of its rapid rate of heating.

18-28. **Effect of Heat Treatment on Corrosion Resistance, Part One: The Relation Between Composition, Quenching Temperature and Corrosion Rate of Stainless Castings.** *Alloy Casting Bulletin,* no. 6, Jan. '46, p. 1-4.

Microstructures resulting from quenching a series of alloys having varying carbon, silicon and molybdenum contents at temperatures from 1200 to 2300° F., and correlation of the structures obtained with the corrosion rates observed for the alloys in the nitric acid test. Specimens were 1x1x⅛-in. squares and ⅛x¼x4¼-in. bars. As-cast specimen blanks were placed in an electric muffle furnace which was at temperature. After reaching the desired temperature in from 4 to 8 min., the specimens were soaked for ½ hr. and then water quenched.

18-29. **Heat Treating and Heating.** T. C. Du Mond. *Materials and Methods,* v. 23, Jan. '46, p. 130-134.

Heating; hardening; quenching; annealing.

18-30. **Nitriding of Aircraft Steels.** P. A. Haythorne. *Iron Age,* v. 157, Jan. 31, '46, p. 44-48.

Depth hardness data covering several aircraft steels not commonly considered nitriding grades, nitrided under varying conditions of temperature, time and ammonia dissociation. Case hardness and penetration characteristics which may be expected from optimum processing conditions. 14 ref.

18-31. **A Theory of the Mechanics of Carburization.** C. Robert McCloskey and John H. Loux. *Steel Processing,* v. 32, Jan. '46, p. 53-56.

Data indicate conclusively that carburization is fully dependent upon the presence of oxidizing potential in the carburizing medium. This would hold true whether carburizing medium be gaseous, liquid or solid.

18-32. **Direct Resistance Heating of Salt Baths for the Patenting of Steel Wire.** W. Heidenhain. *Wire Industry,* v. 13, Jan. '46, p. 39.

Development of a method in which the molten salt contents of the pot act as the resistor. In cases where the distance between the plate electrodes is large the heating process is initiated by creating a liquid bridge between the electrodes by means of a special electric heating ribbon extending between the electrodes. This ribbon is removed from the bath after the flow of current between the electrodes has been established.

18-33. Fabricating and Heat Treating Push Rods at Ford Rouge Plant. *Industrial Heating,* v. 13, Jan. '46, p. 22-24, 26, 28, 148.

Rods are produced by drawing of shell to required dimensions from low carbon sheet steel of deep drawing quality. Shell is drawn closed at one end. To open end, a plug of S.A.E. 5135 steel is electrically welded to provide a surface with wear resistant properties. Subsequent operations involve rolling a groove circumferentially around the body of the rod, grinding the body to finished dimensions on a centerless grinder, grinding the wearing surface of the alloy plug on a surface grinder both to provide a smooth wearing surface and to size the rod to exact length, and then subjecting the rod to a casehardening heat treatment in a continuous furnace.

18-34. Heat Treating Magnesium Castings Without Controlled Atmospheres. *Industrial Heating,* v. 13, Jan. '46, p. 134, 136.

Castings from 10 oz. to 150 lb. were melted in gas-fired equipment. Each part was heat treated in a standard Gehnrich gas-fired industrial oven at temperatures of 730 to 760° F., depending on the particular alloy. Ten thousand castings a day were heat treated in these gas-fired ovens without a single reject due to the heat treating process.

18-35. How to Design Coils for Induction Heating. Frank W. Curtis. *American Machinist,* v. 90, Jan. 31, '46, p. 75-78.

Coil making is not limited to the winding of copper tubing in simple shapes but is an art that necessitates full consideration of the fundamental requirements.

18-36. The Basic Flame Hardening Setups, Part II. *Industry and Welding,* v. 19, Jan. '46, p. 51-53, 84.

Work-holding devices save time and simplify operation.

18-37. Uniformity Problems in Heat Treating Aluminum Alloys. Victor Paschkis. *Aluminum and Magnesium,* v. 2, Jan. '46, p. 12-13, 17, 21.

Individual problems, such as non-uniform cross-section and composite charges, and suggested methods of heat treatment.

18-38. Flame Hardening Small Machined Parts. *Iron Age,* v. 157, Feb. 7, '46, p. 77.

Flame hardening setup handles small parts such as gears, rollers, wheels, shafting, small pins, and other circular parts having diameters between 1½ and 12 in. Virtually eliminates distortion due to hardening. Rejection rate and finishing costs substantially reduced.

18-39. Cyanide Bath Attack on Copper Brazing Material. *Iron Age,* v. 157, Feb. 7, '46, p. 81.

According to test conducted by North American Aircraft, Inc., estimated average weight loss of copper brazing material upon submersion in the regular Perliton liquid casehardening bath is 30 mg. per sq. in. per hr. Also some of the copper strips gained in thickness, probably caused by the formation of a thin copper cyanide coating. Various steps in this test are described.

18-40. Flame Hardening in the Small Shop. William B. Sharav. *Welding Journal,* v. 25, Jan. '46, p. 19-24.

Wide variety of ways in which standard oxy-acetylene apparatus can be combined with materials available in most shops to make a flame hardening setup for doing a particular job.

18-41. Stress Relief of Weldments for Machining Stability: Part II. J. R. Stitt. *Welding Journal,* v. 25, Jan. '46, p. 30s-39s.

Thermal and mechanical stress-relieving treatments and their effects upon the stabilities of weldments during machining operations. Fifteen of the standard 90° cross-weldment specimens were prepared from S.A.E. 1030 steel. One series of specimens of this steel portrays its behavior in the as-welded condition after various amounts of welding had been deposited. Another series shows how the specimens behaved after various stress-relieving treatments, which included both variations in temperature and time at temperature.

18-42. Induction Heat Treatment of Internal Surfaces as Applied to Automotive Industries. Howard E. Somes. *S.A.E. Journal,* v. 54, Feb. '46, p. 45-54, 63.

Application of induction heating to the selective heat treatment of the Ford passenger-car hub, to provide by bore hardening an integral bearing race. Present applications of the process, both in the use of static and progressive cylinder heat treat machines.

18-43. Bright Hardening of Tools and Machine Parts in Controlled Atmospheres. C. E. Peck. *Machinery,* v. 52, Feb. '46, p. 158-163.

Types of atmospheres suitable for bright hardening and equipment for producing these atmospheres: the carbon potential indicator; result of changes in temperature and carbon content; types of steels for bright hardening; hardening high speed steels.

18-44. Flame Hardening Setup for Small Machine Parts. *Machinery,* v. 52, Feb. '46, p. 172-173; *Modern Machine Shop,* v. 18, Feb. '46, p. 134, 136, 138.

Flame hardening setup handles small parts, such as gears, rollers, wheels, shafting, pins, and other circular parts having diameters between 1½ and 12 in. Process has virtually eliminated distortion. Rejection rate and finishing costs substantially reduced.

18-45. British Practice in Heat Treatment of Wrought Aluminum Alloys. E. R. Yarham. *Modern Machine Shop,* v. 18, Feb. '46, p. 146, 148, 150, 152, 154, 156, 158, 160.

Work-hardened alloys; details of full heat treatment; solution treatment; quenching; precipitation and aging treatments; precipitation treatment ("artificial aging"); work hardening alloys; softening of age hardening alloys. Tables give typical mechanical properties of some representative alloys in the annealed and work-hardened conditions.

18-46. Improved Treatments of Aluminum Alloys. Max E. Tatman. *Metal Progress,* v. 49, Feb. '46, p. 323-327.

Heat treatment of 24S alloy, sheet, strip and plate.

Warpage of parts; stretching to straighten; rolled blanks for hydropress, solution heat treatment and mechanical properties.

18-47. **Calibration of Pit Furnaces for Airplane Propellers.** Carl A. Liedholm. *Metal Progress,* v. 49, Feb. '46, p. 361-368.

Studies undertaken to safeguard blade quality in conformity with specification requirements and to eliminate re-heats and heat treating scrap. Routine determinations of the heating characteristics of furnaces for different loads and operating conditions. Brief description of the furnaces and the atmosphere generating equipment, the simple instrumentations and methods used in the temperature and atmosphere calibrations.

18-48. **Characteristics and Uses of Salt Baths.** R. C. Stewart. *Iron Age,* v. 157, Feb. 14, '46, p. 46-52.

Development of the submerged water-cooled electrode salt-bath design has given new impetus to the use of salt baths in production heat treatment of both ferrous and non-ferrous metals and alloys. Other improvements in heat treating, carburizing and nitriding baths; chemical compositions and physical properties of the solutions used.

18-49. **Flame Hardening With the CM-16.** *Oxy-Acetylene Tips,* v. 15, Jan. '46, p. 14.

Because its speed range of 4 to 34 in. per minute is suitable for flame hardening applications, the Oxweld CM-16 cutting machine is frequently used for this work. Machine is equipped with a special attachment and used by manufacturers of mining machinery to flame harden racks by progressive method.

18-50. **Insuring Dimensional Accuracy Through Heat Treating.** *Steel,* v. 118, Feb. 18, '46, p. 90-91, 104.

Coordination of heat treating processes with processing of parts through machining operations is necessary to make sure that close tolerances required actually are obtained. Suitable stress relief a vital factor in controlling residual stresses existing in raw materials or induced by machining.

18-51. **Importance of a Proper Quench.** James McElgin. *Iron Age,* v. 157, Feb. 21, '46, p. 50-51.

Facts regarding the manufacture of 105-mm. H.E. shells at the Chevrolet Ordnance Plant, St. Louis, reveal that by obtaining a more rapid speed of quenching, it is possible to use a lower specification steel. Lower hardness steel facilitates rough machining in the as-forged condition, and the improved, faster quenching results in less free ferrite, which in turn permits a higher drawing temperature, and gives better machinability to the heat treated shell.

18-52. **Forgings and Stampings: Their Manufacture and Production in Aluminium Alloy, Part V.** J. R. Handforth and J. Towns Robinson. *Metal Industry,* v. 68, Feb. 1, '46, p. 83-85.

Heat treatment of forgings.

18-53. **High Frequency Heating.** *Automobile Engineer,* v. 36, Jan. '46, p. 13-19.

Recent developments in design of high frequency induc-

tion heating equipment. Three types of equipment are motor generator, spark gap converter and thermionic oscillator. Special purpose Birlec machines for through-heating, surface hardening, semi-continuous operation, and localized heating described in detail. Operating costs for one of the machines.

18-54. **The Hardenability Concept.** John H. Hollomon and L. D. Jaffe. *Metals Technology,* v. 13, Jan. '46, T. P. 1926, 12 p.

An analysis of the nature of the decomposition of austenite and of the effects of the alloying elements on the rates of bainite and pearlite transformation indicates that in some cases pearlite and in others bainite will limit the formation of martensite on continuous cooling. Since alloying elements may have different effects upon the bainite reaction than upon the pearlite reaction, it is necessary to consider two hardenabilities—the pearlitic and the bainitic. 23 ref.

18-55. **Hardenability and Quench Cracking.** L. D. Jaffe and John H. Hollomon. *Metals Technology,* v. 13, Jan. '46, T.P. 1927, 8 p.

To attain the hardenability required for a steel part to be fully hardened by a given treatment with a minimum susceptibility to quench cracking and to retention of austenite, composition should be such that further slight additions of each element give as great a fractional increase of hardenability per degree lowering of the martensite temperature range as possible. On the basis of the data now available, this means that for hypo-eutectoid steels *(a)* carbon should be as low as possible; *(b)* silicon should be as high as is consistent with good steel quality and toughness; *(c)* manganese, chromium, and nickel concentrations should bear a definite relationship to each other and should be as high as is necessary to give the required bainitic hardenability. 17 ref.

18-56. **Heat Treatment of High Speed Steel.** Morris Cohen and Paul Gordon. *Iron Age,* v. 157, Feb. 28, '46, p. 42-47.

Modern practice of heat treating high speed steels in order to obtain desired physical properties is summarized; introduces, with the aid of photomicrographs, background concepts of structural changes which occur as a result of varied heat treatments. An aid in controlling room temperature structures in tungsten-molybdenum steel is also presented. 6 ref.

18-57. **Radio (High Frequency) Heating.** D. B. Leason. *Refractories Journal,* v. 22, Jan. '46, p. 13-17.

Essential differences between high frequency heating and other methods of heating. Two distinct types of high frequency heating are dielectric and induction. For heating the interior of parts made of materials that are poor conductors, high frequency heating is far superior to heat transfer methods.

18-58. **Cold-Die Quenching.** A. F. Gallistel. *Steel,* v. 118, March 4, '46, p. 129, 172, 174, 176, 178.

Indianapolis company hardens small parts without distortion by quenching in water-cooled steel dies.

18-59. Precipitation Hardening Stainless Steel. *Steel,* v. 118, March 4, '46, p. 136, 138.

Alloy has three specific aging temperatures. It will harden uniformly throughout unusually heavy sections without difficulties generally encountered.

18-60. Induction Hardening of Precision Steel Parts. William Boyle. *Materials and Methods,* v. 23, Feb. '46, p. 425-428.

Special work holding and quenching fixtures, plus automatic timing, result in volume production at reduced cost.

18-61. German Practice in Solution Heat Treatment of Rolled Aluminum Alloys. W. Lott; translated by B. M. Pearson. *Materials and Methods,* v. 23, Feb. '46, p. 429-431.

Deformation stresses in formed aluminum alloy sheet can be removed by a 2-min. solution heat treatment at 932° F. (From an article in *Aluminium (Berlin),* v. 25, 1943, p. 279-282.

18-62. Stabilizing and Stress Relief Effects on Welded 18-8. Wilson G. Hubbell. *Western Machinery and Steel World,* v. 37, Feb. '46, p. 66-69.

Tests show that exhaust manifolds will resist corrosion where a combined precipitate of columbium or titanium carbides and chromium carbides exists after sensitizing the annealed materials. Photomicrographs show that even throughout the annealing heat treatment accomplished by cooling in air from 1950° to 2000° F., a percentage of the carbon will remain combined with columbium or titanium. This leaves a small amount of uncombined carbon which in theory should combine with the chromium if held within the sensitizing range for a sufficient period of time. Amount of available carbon left for the formation of chromium carbides is very small.

18-63. A Precipitation Hardening Stainless Steel of the 18% Chromium, 8% Nickel Type. R. Smith, E. H. Wyche and W. W. Gorr. *Steel Processing,* v. 32, Feb. '46, p. 95-97, 103, 115.

Mechanism of the precipitation hardening reaction; composition and effect of various elements on stainless "W"; heat treatment; solution annealing; aging (precipitation hardening); microstructure; physical properties; mechanical properties; impact strength; fatigue tests; properties at elevated temperatures; corrosion resistance; weldability.

18-64. New Carburizing Techniques Feature Operations at Canadian Acme Plant. Part I. *Industrial Heating,* v. 13, Feb. '46, p. 222-224, 226, 228, 230.

Carbon restoration process; gas carburizing methods and equipment used.

18-65. Chase Euclid Plant Produces Brass Cartridge Cases and Steel Mortar Shells. Part V. *Industrial Heating,* v. 13, Feb. '46, p. 232, 234, 236, 238.

Heat treating department of plant, where punches, dies, tools and implements used in stamping, pressing, machining and other operations receive treatment. Typical punch-and-die sets used.

18-66. **"Seven-in-One" Induction Hookup Hardens Navy Gun-Mount Parts.** *Industrial Heating,* v. 13, Feb. '46, p. 240, 242, 244, 246, 248.

Seven distinctive hardening stations are connected to one 125-kw. 9600-cycle standard Tocco process motor-generator set and are hardening as many different parts ranging from a bearing roller ⅞ in. diameter by 1⅝ in. long, up to 82-in. diameter gun-training gears. Induction heat treatment has been applied to some 150 components. In addition to the 125-kw. unit, an 80-kw. Tocco machine also used.

18-67. **Sub-Zero Treatment of Steels.** H. C. Amtsberg. *Industrial Heating,* v. 13, Feb. '46, p. 262, 264, 266, 268, 270, 272, 274, 276.

Presentation of fundamentals of cooling hardened steels to temperatures considerably below room temperatures properly correlated with the basic treatment cycle and related structural changes. 11 ref.

18-68. **Bright Annealing of Wire in Bell-Type Furnace at Atlas Tack Corp.** *Industrial Heating,* v. 13, Feb. '46, p. 278, 280, 282, 284.

Required headroom made available by raising the roof in a small section of the building and installing an elevator over the furnace to raise and lower it for the respective furnace charges. Bases were put on wheels so that they could be moved on tracks to various locations of loading, heating, gas purging, cooling and unloading. Shows bell muffles which enclose the work to be heat treated and which in turn are enclosed by the furnace shell which contains the gas-fired radiant tubes. Shows equipment which supplies the controlled atmosphere within the bell during the annealing process.

18-69. **Heat Treatment of High Speed Steel. Part 2.** Morris Cohen and Paul Gordon. *Iron Age,* v. 157, March 7, '46, p. 52-57.

Continues discussion of austenite decomposition; also analyzes technical aspects of the role of tempering and its relation to the complex phenomena of secondary hardness.

18-70. **Dimensional Stabilization by Deepfreeze.** *Machinery (London),* v. 68, Feb. 14, '46, p. 215-216.

Ten standard hardened and ground bearings measured on a comparator, then cycled six times from 212 to −120° F., coming to room temperature between each cycle. Length of time at heat and cold was one hour. Results of this experiment outlined in table.

18-71. **What Frequency for Induction and Dielectric Heating?** Russell A. Nielson. *Steel,* v. 118, March 11, '46, p. 102, 104, 106, 112.

Tells what frequency is best suited for each type of induction and dielectric heating job.

18-72. **The Isothermal Heat Treatment of Steel.** E. F. Watson and J. McArthur. *Machinery (London),* v. 68, Feb. 28, '46, p. 265-271.

Advantages of isothermal heat treatment over conventional quench and temper methods.

18-73. **Heat Treatment of High Speed Steel. Part 3.** Morris Cohen and Paul Gordon. *Iron Age,* v. 157, March 14, '46, p. 68-73.

Relationship of time and temperature to maximum secondary hardness and to the kinetics of the tempering process. Complexities of the hardening treatment with respect to retained austenite also considered.

18-74. **Production Line Heat Treatment of Stainless Bar Stock.** J. F. Sullivan. *Metal Progress,* v. 49, March '46, p. 523-525.

With six oil and six electric furnaces (some of which are large enough to take stock 22 ft. long) an output of more han 3,000,000 lb. per month was maintained during war. This included hardening, tempering, annealing and stress relieving operations to produce bar hardnesses ranging on customers' order from Brinell 140 to 321. Several features of the departmental layout and furnace operation described.

18-75. **High Intensity Induction Heating.** Wesley M. Roberds. *Steel,* v. 118, March 18, '46, p. 104-107, 161-165.

Carbon steels may be fully surface hardened at high speed through use of high power concentration.

18-76. **Adjustable Induction Heating Coils.** *Steel,* v. 118, March 18, '46, p. 118.

Experimental work facilitated by removable inserts which largely eliminate coil changing in setting up induction heating equipment.

18-77. **Frequency in Induction and Dielectric Heating.** Russell A. Nielson. *Machine Tool Blue Book,* v. 42, March '46, p. 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 198, 200, 202.

Frequency heating beginning with the application of very low frequencies and progressing up the scale to frequencies as high as 100 million cycles per second.

18-78. **Heat Treatment of High Speed Steel. Part 4.** Morris Cohen and Paul Gordon. *Iron Age,* v. 157, March 21, '46, p. 61-65.

Tempering and the ramifications of interrupted cooling following tempering; data illustrating the improvement of physical properties obtained.

18-79. **Subzero Treatment Simplifies Hardening of Alloy Carburizing Steels.** H. E. Boyer and H. C. Miller. *Materials and Methods,* v. 23, March '46, p. 730-734.

Hardness tests and metallographic examination prove that low-temperature treatments stabilize carburizing alloy steels.

18-80. **Quenched Steel Castings.** C. W. Farrar. *Canadian Metals and Metallurgical Industries,* v. 9, March '46, p. 37-39.

History of water quenching and some of its more common effects on the properties of steel castings.

18-81. **Induction Hardening Steam Hammer Piston Rods.** *Steel,* v. 118, March 25, '46, p. 121, 142.

Vertical induction heat treatment apparatus. Heat treated, completely finished and ground piston rod is suit-

ably preheated, and a water-cooled induction heating unit slipped around ram taper end. Rod is revolved at a speed commensurate with its size and desired heating rate. Pass then is made with induction heating ring and quench spray. Rod surface is raised to approximately 1600° F.—a bright cherry red—and is progressively hardened on surface by immediate impingement of a traveling cold-water spray attached directly beneath induction ring.

18-82. **The Effect of Stabilizing and Stress-Relief Heat Treatment Upon Welded 18-8 Stainless Steel.** Wilson G. Hubbell. *Steel Processing,* v. 32, March '46, p. 181-186.

Stabilizing treatment obtained by heating welded section of 18-8 types 321 and 237 stainless steel for 30 min. at 1650° F. produces resistance to attack by corrosive aqueous solutions and electrolytes. There appears to be no justification for assuming that any substantial and practical benefit will be obtained by applying this type of heat treatment to aircraft exhaust manifolds. Manufacturing problems which would add to the cost of the finished product by heat treatment at 1600° F. are: *(a)* removal of scale by sandblasting or special pickling solutions; *(b)* increased furnace capacity for heat treatment at this temperature for the desired length of time; *(c)* warpage on the finished part.

18-83. **Heat Treatment of High Speed Steel. Part 5.** Morris Cohen and Paul Gordon. *Iron Age,* v. 157, March 28, '46, p. 55-62.

Subzero treatment of high speed steel is thoroughly covered with respect to both the theoretical and practical aspects, as well as the effects obtained from tempering treatments following the hardening operation. 14 ref.

18-84. **An Examination of Slow Cooling Methods.** J. W. Barker and E. R. Cole. *Iron and Steel Engineer,* v. 23, March '46, p. 84-89.

Résumé of slow cooling methods as practiced in the steel industry today.

18-85. **Modern Heat Treat Department Essential to the Manufacture of Allison Engines.** W. G. Guthrie. *Industrial Heating,* v. 13, March '46, p. 404-406, 408, 410, 412, 414, 416, 418, 420.

Department layout; control room; normalizing furnace; pusher-type controlled atmosphere hardening furnace; copper plating for selective carburizing; carburizing furnaces; pit-type annealing furnaces; atmosphere production and control; rotary and pusher-type hardening furnaces; die quenching equipment; shotblast finishing; nitriding furnaces; instrumentation.

18-86. **The Temperature Range of Martensite Formation.** R. A. Grange and H. M. Stewart. *Industrial Heating,* v. 13, March '46, p. 440, 442, 444, 446, 448, 450.

Data which make possible selection of the lowest quenching temperature at which no martensite will form, and the highest quenching temperature at which virtually all martensite will form, for 14 carbon and low-alloy steels. (Condensation of paper for American Institute of Mining and Metallurgical Engineers.)

18-87. **Practical Studies of High-Frequency Currents for Testing and Heating.** *Industrial Heating,* v. 13, March '46, p. 455-456, 458, 460.

Stress comparison; metallurgical characteristics of induction hardened steel; austenizing characteristics of medium-carbon steels. (Review of papers read before American Society for Metals.)

18-88. **Carburizing and Decarburizing of Steel.** *Industrial Heating,* v. 13, March '46, p. 462, 464, 466.

Case-depth measurement; graphite in hypo-eutectoid steels; surface decarburization of steel. (Review of papers read before American Society for Metals.)

18-89. **Heat Treating and Galvanizing Performed in Commercial Metals Treating Co. Plants. Part II. Heat Treating and Galvanizing.** *Industrial Heating,* v. 13, March '46, p. 512, 514, 516, 518, 520.

Discusses plant set up primarily for liquid cyaniding and continuous hardening and galvanizing facilities.

18-90. **New Tasks for Welding Torches.** Arthur Havens. *Welding Engineer,* v. 31, March '46, p. 46-48.

Oxy-acetylene welding torches used to apply local heat where fitting is difficult, for straightening, shrink fitting and to loosen stubborn nuts and pipe fittings.

18-91. **Induction Heating. Part I.** Gilbert C. Close. *Modern Machine Shop,* v. 18, April '46, p. 136-138, 140, 142, 144.

Theory and application of the induction heating process in brazing and forging.

18-92. **Atmosphere Calibration for Heat Treating Airplane Propellers.** Carl A. Liedholm. *Metal Progress,* v. 49, April '46, p. 744-749.

Atmospheric controls that enable heat treatment of propellers without surface decarburization. It is possible even to replace carbon in the surface layers of steel that have been slightly decarburized by preceding routine manufacturing operations such as shank upsetting or copper filleting of the internal blade edges.

18-93. **Quenching Water Requirements of Induction Heated Parts.** B. R. Miller. *Metal Progress,* v. 49, April '46, p. 750-752.

Parts quenched varied in weight from 336 to 2.6 lb. and the heating cycle from 130 to 2.2 sec. The quench water requirements varied from 807 to 22 gal. per min. Examples show the relation of water volume, water pressure, heat supplied, duration of heating and quenching cycle, and hardness obtained, together with pictures of the parts tested.

18-94. **Hardening by Grinding.** A. Holloway. *Machinery (London),* v. 68, March 14, '46, p. 305-306.

Two examples showing that hardening as well as softening can take place during grinding operation caused by surface layers reaching such temperature that partial, or even full, austenizing of material takes place, to be followed by very rapid air cooling or mass quenching. Result is fully or partially martensitic layer.

18-95. **Simple Setup for Small-Lot Flame Hardening of Valve Plugs.** R. H. Brooks. *Welding Journal,* v. 25, March '46, p. 245-246.

Simple hand-operated jig has been set up for flame hardening plugs used in valves ranging from 1 in. to 16 in. pipe size. Plugs are made of type G. A. Meehanite, which has a basic hardness of Brinell 250. Using the progressive flame hardening method followed by a water quench, a $\frac{1}{16}$-in. case with a Brinell hardness of 400 is produced at the rate of approximately 12 in. per min. Operating conditions such as flame intensity, speed of travel of the heating flame, and type of steel being treated can be varied to produce special hardness and depth.

18-96. **Eliminating Brittleness in Aluminum-Silicon Bronze Hydraulic Sleeves for Aircraft.** Lawrence J. Barker. *Automotive and Aviation Industries,* v. 94, April 1, '46, p. 34-35.

For complete elimination of brittleness the best procedure is to heat treat the sleeves after machining and before cadmium plating at a temperature of 1050° F. for 2 hr. followed by cooling in air. This treatment eliminates completely or satisfactorily reduces the delta phase without distortion of the sleeve itself. It also serves as a strain anneal for any possible stresses imposed by machining.

18-97. **Wax Masking for Selective Copper Plating.** C. E. Ernst. *Metal Finishing,* v. 44, April '46, p. 155-156.

Wax with high melting point is used. It is held at 240 to 260° F. in a rectangular dipping tank, electrically heated and thermostatically controlled. Gears are prepared for masking by running them through an electrolytic alkaline cleaning cycle and a hydrochloric acid dip and rinse. Gears must be at the correct temperature, which is 110 to 120° F. (Reprinted from *Metal Progress,* Nov. 1945.)

18-98. **Induction Heating of Hollow Metallic Cylinders.** Andrew Gemant. *Journal of Applied Physics,* v. 17, March '46, p. 195-200.

Deals with heat input to hollow cylindrical metal cores subjected to induction heating. Rigorous expression for heat input, valid for whole frequency range, is developed. Example shows how equation is used for numerical computations. Existing approximate formulas for low frequency and high frequency range are checked by means of rigorous equation.

18-99. **Effect of Heat Treatment on the Endurance Limit of Alloyed Gray Cast Iron.** T. E. Eagan. *Foundry Trade Journal,* v. 78, April 4, '46, p. 361-365.

Seven endurance tests show that, in general, heat treatment to obtain high tensile strength does not give a proportionate increase in endurance limit; that the normal harden and temper heat treatment to attain high tensile strength does not necessarily produce any increase in endurance limit (under certain conditions the endurance limit may be lowered by such a treatment); that the original as-cast structure has a profound influence on the endurance limit obtained after heat treatment.

18-100. **New Carburizing Techniques Feature Operations at Canadian Acme Plant. Part III.** *Industrial Heating,* v. 13, April '46, p. 610, 612, 614, 616.

Cycle annealing and miscellaneous furnaces.

18-101. **Annealing Navy Anti-Aircraft Gun Mounts at the Babcock & Wilcox Alliance Plant.** J. C. Fesler. *Industrial Heating,* v. 13, April '46, p. 618, 620, 622, 624, 626.

Furnace designed for operation at 1450° F. is 35 ft. long by 19 ft. wide by 9 ft. high and will handle a charge 35 ft. long by 17 ft. wide by 6 ft. high. The bulk construction is of 8-in. structural-steel, channel buckstays fastened at the bottom to the furnace foundation with anchor bolts and tied across the top laterally by the roof trusses. The furnace is supported on columns so that the circulation of air around the car wheels and bearings is possible.

18-102. **Induction Hardening Ram-Taper Areas of Heppenstall Steam-Hammer Piston Rods.** *Industrial Heating,* v. 13, April '46, p. 628, 630, 632.

Heat treated, completely finished and ground piston rod, suitably preheated, is inserted in the new specially constructed machine. Water-cooled induction heating unit is slipped around the ram-taper end. Rod is revolved at a speed commensurate with its size and the desired heating rate. A pass is then made with the induction heating ring and quench spray. Rod surface is raised to approximately 1600° F.—a bright, cherry red—and is progressively hardened on the surface by the immediate impingement of a traveling cold-water spray attached directly beneath the induction ring; produces a hardened case approximately $\frac{3}{16}$ in. deep from the surface of the ram-taper inwardly and extending to a point slightly above the end of the taper.

18-103. **Williamson Plant Specializes in High-Grade Work to Close Specifications.** *Industrial Heating,* v. 13, April '46, p. 686, 688, 690, 692, 698.

Plant is set up to perform annealing, liquid carburizing, hardening, tempering and stress relieving on ordinary steels and heat treatment of high speed toolsteels, high-carbon, high-chromium toolsteels, and other alloy grades. Can handle satisfactorily pieces of considerable size, up to 500 lb. in weight and 2 ft. in maximum length, width and height.

18-104. **Hot Oil Quenching.** D. C. Miner. *Steel,* v. 118, April 29, '46, p. 88-89, 118, 121.

With uniformity of heating and close temperature regulation, hot quenching in oil will fill a needed place in heat treatment of steel between the lower temperature oil quench and the salt quench method.

18-105. **Spin Hardening Small Machined Parts.** *Industry and Welding,* v. 19, April '46, p. 49-50.

Flame hardening setup handles such small parts as gears, rollers, wheels, shafting, small pins and other circular parts with diameters between 1½ and 12 in. Flame hardening process virtually eliminates the distortion;

rejection rate and finishing costs have been substantially cut down.

18-106. **Casehardening Gears.** L. Sanderson. *Aircraft Production,* v. 8, April '46, p. 193-194.

Advantages of the salt bath furnace for carburizing and tempering.

18-107. **Aircraft Steels.** P. A. Haythorne. *Iron and Steel,* v. 19, April '46, p. 142-146.

Investigation presents depth-hardness data obtained for several aircraft steels nitrided under varying conditions of temperature, time, and ammonia dissociation. Curves indicating characteristics of case hardness and penetration illustrate properties which may be expected from optimum processing operations.

18-108. **Hardenability Effects in Relation to the Percentage of Martensite.** J. M. Hodge and M. A. Orehoski. *Metals Technology,* v. 13, April '46, T.P. 1994, 10 p.

Effects of manganese, silicon, nickel and molybdenum on hardenability, in terms of 99.9, 95 and 50% martensite, have been studied by means of metallographic examination of end quench tests from several series of steels with only one alloy variable. Hardenability effects of the alloying elements are essentially the same on the basis of the three criteria studied. Set of curves depicting the hardenabilities of iron-carbon alloys on the basis of the 99.9, 95 and 50% martensite criteria has been derived from a study of a series of nickel-molybdenum steels in which carbon was the only variable. It is proposed that the relationship between full martensite hardenability and 50% martensite hardenability is a function only of the base hardenability of the iron-carbon alloy.

18-109. **The Temperature Range of Martensite Formation.** R. A. Grange and H. M. Stewart. *Steel Processing,* v. 32, April '46, p. 249-252.

Data from study of martensite formation in 14 carbon and low-alloy steels may be directly used in the following ways: *(a)* for selecting the lowest quenching temperature at which no martensite will form; *(b)* for selecting the highest quenching temperature at which virtually all martensite will form, thereby avoiding quenching to an unnecessarily lower temperature with attendant danger of cracking; and *(c)* in producing a mixture of tempered martensite and bainite, which in high carbon steels has been found to possess somewhat better ductility than tempered martensite, yet does not require the prolonged transformation time necessary for a completely bainitic (austempered) structure.

18-110. **The Overheating and Burning of Steel.** A. Preece, A. Hartley, S. E. Mayer and J. Nutting. *Iron and Steel Institute Advance Copy,* March '46, 18 p.

Overheating properties of a wide variety of steels have been examined and temperatures of overheating determined on basis of fracture and etch tests. An unexpected correlation has been observed between the inclusion content of a steel and its overheating temperature. Furnace conditions, such as composition of the atmosphere, soak-

ing time, and the rate of cooling, have been studied in relation to overheating. Possibility of a slow cooling treatment as an effective method of restoring overheated steels is indicated. Effect of overheating on tensile and Izod properties.

18-111. **The Effect of Oxygen on the Isothermal Transformations of Steel, and a Suggested Test for Burning.** F. C. Thompson and L. R. Stanton. *Iron and Steel Institute Advance Copy,* March '46, 5 p.

Samples of a series of plain carbon steels have been locally burnt, and subsequently isothermally quenched to various temperatures. Results show that certain steels are rendered more reactive by burning, and this suggests a displacement of the inherent S-curve. The deduction is made that this behavior is due to the introduction of oxygen during burning, which probably acts indirectly.

18-112. **Induction Heating, II.** Gilbert C. Close. *Modern Machine Shop,* v. 18, May '46, p. 172-174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 194.

Surface hardening technique; design of heating coils; progressive hardening.

18-113. **Rapid Heating of Steels.** Frederic O. Hess. *Iron and Steel Engineer,* v. 23, April '46, p. 73-82.

Rapid heating of steels, a trend which was accelerated by the war, is finding more and more applications. Basic principles and developments upon which rapid heating depends; a number of applications.

18-114. **Observations on the Impact Strength of Alloy Steels Hardened From Cyanide Baths.** Sidney M. Lenhoff and Louis F. Roth. *Metal Progress,* v. 49, May '46, p. 960-967.

Data and information on the impact properties of steels heated in cyanide. During course of investigation, various other treatments were run in an effort to achieve optimum results. Where wear resistance is the sole requirement, a cyanide heat is of great value, but if impact is also present, one should proceed with caution.

18-115. **Steel Hardening Without a Furnace.** T. J. Noble. *Industrial Gas,* v. 24, May '46, p. 7-8.

Direct flame, or furnaceless heating, is adaptable to a wide range of heat treated products, from small to large. Applications to gears and machine parts shown. Chief advantage is localized heating effect.

18-116. **Practical Phases of Applying High-Speed Gas Heating.** Frederic O. Hess. *Industrial Gas,* v. 24, May '46, p. 9-10, 26-27.

Process lends itself to high production methods. Speed of the operation brings about some additional benefits resulting from small grain sizes and greater hardness, and therefore improved performance characteristics. Equipment illustrated, giving comparable production figures.

18-117. **Heating by Immersion and Submerged Combustion.** Charles C. Eeles. *Industrial Gas,* v. 24, May '46, p. 14-15, 27-28.

Principles of immersion heating and submerged combustion. Includes solution heating data sheet.

18-118. **Temperature Uniformity in Heat Treatment of Coiled Metal.** Victor Paschkis and J. A. Doyle. *Wire and Wire Products,* v. 21, May '46, p. 369-374, 407-408.

Investigation of the actual degree of uniformity obtained in commercial practice when heating and cooling metal in coils or in batches or piles, in order to demonstrate if methods are really adequate to meet present requirements for better metal products.

18-119. **Flame Hardening Cast Iron.** R. H. Olmsted. *Foundry,* v. 74, May '46, p. 152-155, 284, 286.

Principal item responsible for development of flame hardening as a manufacturing process for gray iron has been the improvement in the oxygen and acetylene equipment which has made it possible to duplicate results. Only those analyses or compositions which have sufficient hardenability characteristics in the casting section are here considered for the flame hardening process—principally, the so-called "pearlitic irons". Flame hardening of cast iron compared with other forms of heat treating.

18-120. **Temperature Range of Martensite Formation.** R. A. Grange and H. M. Stewart. *Steel,* v. 118, May 20, '46, p. 126, 129-130.

Upper limit of martensite range and often the proportion of martensite that forms on cooling are facts needed for isothermal quenching and martempering. Method for calculating Ms from chemical composition also explained.

18-121. **Shrinking and Hardening Track Rollers in One Operation.** *Machinery (London),* v. 68, April 25, '46, p. 521-525.

Assembly is achieved by shrinking rollers on the hub after they have been expanded by heating to a high temperature. As shrinkage occurs, the roller treads and outside surfaces of the roller flanges are simultaneously hardened by a copious water quench, directed on the rollers completely around their circumference. With the Tocco process, the combined assembling and hardening operation is completely automatic, except for loading and unloading the work, and takes an average of only 4 min. per assembly.

18-122. **Selective Induction Hardening of Previously Hardened Parts.** Robert C. Gibbons. *Steel,* v. 118, May 27, '46, p. 92-93, 134, 135

Aircraft parts such as gears and pinions are hardened to an intermediate hardness, machined to final size, then induction hardened to the required hardness.

18-123. **Effect of Frequency in Induction Heating.** Russel A. Nielson. *Tool Engineer,* v. 16, May '46, p. 23-25.

Formulas entailing higher mathematics determine what frequency is best for induction heating. Problem approached from fundamental viewpoint beginning with the application of very low frequencies and progressing up the scale to frequencies as high as 100 million cycles per sec.

18-124. **Heat Treatment of Stainless Steel.** Haig Solakian. *Iron Age,* v. 157, May 30, '46, p. 46-49

Practical aspects of heat treating stainless steels of the air hardening and high-carbon chromium variety in salt

baths. Functions of the preheat, high-heat and quench baths in heat treating articles efficiently and economically; recommendations covering the use of different types of containers for these three operations.

18-125. **Preheating and Stress Relieving With Induction Heating.** Lombard Smith. *Western Metals,* v. 4, May '46, p. 36-38.

18-126. **Flame Hardening Setup for Small Machined Parts.** William B. Sharav. *Welding Journal,* v. 25, April '46, p. 328.

Handles small parts such as gears, rollers, wheels, shafting, small pins and other circular parts having diameters between 1½ and 12 in. Process eliminates distortion due to hardening. Rejection rate and finishing costs substantially reduced.

18-127. **Gas Carburizing—a New Controlled Atmosphere Plant.** *Metallurgia,* v. 33, April '46, p. 317-319.

Brief description of a gas carburizing system and of furnace design. Advantages of gas carburizing; general outline of system; carrier gas preparation plant; furnace design.

18-128. **High-Speed Heating With Gas Provides Heat Treat Tool.** C. W Eigenbrot. *Materials & Methods,* v. 23, May '46, p. 1313-1316.

Hardening machine is working on a standard size 14.625-in. o.d., 10 diametral pitch gear with a ½-in. face and a pitch diameter of 14.6 in. Heat source consists of two special burners of superheat type, ring-shaped with restricted outlet slot on inside faces, so that gear indexes down inside burners and is totally encased in high-velocity streams of hot products of combustion. Total of five index stations on the machine—one for loading, two for heating, one for quenching, and one for cooling. Indexing is hydraulically operated, responding to automatic controls which determine the time-temperature treatment of the gear.

18-129. **Uncertainties in Hardenability.** *Industrial Heating,* v. 13, May '46, p. 778-782.

Various uncertainties involved in the measurement of the hardenability of steel.

18-130. **Fox Steel Treating Co. Specializes in Tool, Die, and Gage Precision Work.** *Industrial Heating,* v. 13, May '46, p. 865-870.

Plant equipment; furnaces—box type; electrically heated tempering furnace; salt-bath furnaces; auxiliary equipment.

18-131. **High Speed Hardening Without Atmospheres.** W. B. Macnerland. *Steel,* v. 118, June 3, '46, p. 107, 152.

Use of inexpensive and simple equipment adapts conventional open fire furnace so that tungsten and molybdenum high speeds can be satisfactorily handled. Process consists of preheating work at 700 to 1000° F. and immersing tool in a molten boric acid bath which has the appearance of any normal salt bath. Prior to immersion the bath is heated to conventional hardening temperature.

18-132. **Improving High Speed Steels.** *Steel,* v. 118, June 3, '46, p. 116.

Easily assembled and procured materials adapt a conventional furnace for high speed steel heat treating use. Desegatizing process.

18-133. **Plain Carbon Steels — Martensite Formed From Pearlite by Local Heating.** W. J. Wrazej. *Iron and Steel,* v. 19, May 10, '46, p. 237-239.

Discusses various effects arising from the localized heating of some carbon steels. Problem arose from an investigation of hardened layer produced on a shell which had been subjected to a blast of hot gases when fired from a gun. Nature of this layer is considered, together with some experiments in which the localized heating of eutectoid steels was produced by friction. Effect of localized transient heating depends only on the temperature reached and not on the mode of application of the heat.

18-134. **Drop Forgings—Some Aspects of Overheating.** H. J. Merchant. *Iron and Steel,* v. 19, May 10, '46, p. 323-332.

Various aspects of the causes of and factors influencing overheating; the nature and detection of overheating; methods adopted to prevent and reclaim overheated forgings.

18-135. **Overheating and Burning—Fracture and Etch Tests for the Examination of Steels.** A. Preece, A. Hartley, S. E. Mayer, and J. Nutting. *Iron and Steel,* v. 19, May 10, '46, p. 332-339.

Investigation undertaken to examine relative importance of variables such as temperature, furnace atmosphere, heating and cooling rates, etc., on overheating properties of steels for forging and hot working. Overheating temperatures of a large number of steels made by different processes were determined by fracture and etch tests. Izod tests also used. Results show relative importance of furnace conditions and some interesting features connected with composition of the steel.

18-136. **Isothermal Transformations—the Effect of Oxygen, and a Suggested Test for Burning.** F. C. Thompson and L. R. Stanton. *Iron and Steel,* v. 19, May 10, '46, p. 343-345.

Results show rate of breakdown of austenite may be accelerated by burning. Presence of oxygen, directly or indirectly, makes the steel more reactive, i. e., it moves the curve to the left. Since decarburization during burning is only slight, it cannot be the sole cause of the more rapid transformation found in the burnt areas. When the product of the decomposition is martensite, effects of burning are not confined to the grain boundaries but penetrate to the center of the grains. Rate of austenitic decomposition is affected by the presence of gases in the material.

18-137. **The Overheating Phenomenon—Its Possible Explanation as a Precipitation Effect.** J. Woolman and H. W. Kirkby. *Iron and Steel,* v. 19, May 10, '46, p. 346-353.

Discusses various preliminary experiments carried out on: effect of heat treatment on material showing facets; effect of rate of cooling from the overheating temperature; determination of minimum overheating tempera-

ture; effect of furnace atmosphere on the formation of facets; effect of forging on overheated steel.

18-138. **Overheating of Drop Forgings.** H. J. Merchant. *Canadian Metals & Metallurgical Industries,* v. 9, May '46, p. 23-29.

Some aspects of overheating, its nature and detection, and methods adopted to prevent and reclaim overheated forgings. (Paper for British Iron and Steel Institute.)

18-139. **Practical Toolroom Heat Treatment. Part 1.** F. J. McMulkin. *Iron Age,* v. 157, June 6, '46, p. 60-65.

Reviews the various classifications of toolsteels and introduces the principles of heat treatment, with particular emphasis on precautions to be observed during the heating cycle.

18-140. **Induction Heating.** *Automobile Engineer,* v. 36, May '46, p. 204-206.

American developments in the treatment of internal surfaces.

18-141. **Gas Carburizing.** *Automobile Engineer,* v. 36, May '46, p. 219-220.

Advantages of the process; general outline of the system; carrier gas preparation plant; furnace design.

18-142. **Aluminum Alloy Forgings.** *Metal Industry,* v. 68, May 31, '46, p 425-426.

Results of recent investigation on high-temperature oxidation in aluminum forgings. Object of tests was to establish a standard inspection procedure for acceptance or rejection of aluminum alloy forgings as regards presence of high-temperature oxidation. Macrographs and tensile test results need to be supplemented by microscopic tests to obtain a definite classification of a forging.

18-143. **Extending the Jominy Scale.** John Erb. *Iron Age,* v. 157, June 13, '46, p. 48-51.

Simplified method for estimating the hardness of quenched and tempered steel from hardenability data. Tables and charts boil down the essentials into a form readily usable in every-day work. Practical examples of the use of this method in selecting a steel for a copper brazed assembly are given.

18-144. **Practical Toolroom Heat Treatment, Part 2.** F. J. McMulkin. *Iron Age,* v. 157, June 13, '46, p. 56-59.

Six means by which the practical heat treater can avoid decarburization of toolsteels during heat treatment, with particular emphasis placed on the use of proper furnace atmospheres in obtaining desired surfaces. Raises the question of the effect of various atmospheres on the physical properties of the steel.

18-145. **The Removal of Hydrogen From Steel.** J. H. Andrew, H. Lee, A. K. Mallik, and A. G. Quarrell. *Iron and Steel Institute Advance Copy,* May '46, 47 p.

A systematic investigation of the removal of hydrogen from steels by heat treatment under isothermal conditions has been carried out, and it is shown that the rate of removal in the intermediate range is high, and that, for

certain steels, there is also a peak on the removal curve corresponding to transformation in the pearlitic region. The law governing hydrogen removal in the austenitic range has been determined experimentally and the empirical relationship supported by theoretical treatment. Hairline crack formation cannot be explained by a simple hydrogen pressure or hydrogen embrittlement theory, but depends upon the formation of a hydrogen-rich constituent which is not necessarily austenitic in nature. 4 ref.

18-146. **Aluminum Forging and Heat Treating Furnaces at Alcoa New Castle Works.** *Industrial Heating,* v. 13, June '46, p. 944-960.

Engaged mainly in the production of aluminum alloy forgings, the New Castle, Pa., works of the R. F. C. operated by the Aluminum Co. of America is equipped with mechanical forging presses ranging in size from units having a capacity of 700 tons to large presses having capacities of 2500 tons. Numerous furnaces incorporating special features are used to heat the aluminum alloy billets for forging, and to heat treat the finished forgings.

18-147. **Industrial Heat Treating Furnaces in Germany. Part II.** Cary H. Stevenson. *Industrial Heating,* v. 13, June '46, p. 962-978.

Report covering the findings of studies and questions involving the plants and personnel of 30 plants throughout Germany—both users and manufacturers of furnaces and furnace parts.

18-148. **Practical Toolroom Heat Treatment.** F. J. McMulkin. *Iron Age,* v. 157, June 20, '46, p. 64-68.

Quenching toolsteels; precautions to avoid warping and cracking. Tempering, and its importance as a controlling factor in obtaining hardness and toughness.

18-149. **Practical Toolroom Heat Treatment. Part 4.** F. J. McMulkin. *Iron Age,* v. 157, June 27, '46, p. 55-59.

Types of salt baths in current use; use of salt baths in interrupted and isothermal quenching.

18-150. **Gas Carburizing Plant.** *Engineering,* v. 161, May 24, '46, p. 488-489.

A modern system of carburizing ferrous metal in a gaseous atmosphere, developed by the Incandescent Heat Co., Limited, Birmingham, England.

18-151. **Decarburization in Highly Stressed Steels.** P. A. Haythorne. *Iron Age,* v. 158, July 4, '46, p. 52-61.

Evaluation of decarburization and its effects on the properties of heat treated, highly stressed aircraft steels. A new technique for accurate determination of surface carbon depletion.

18-152. **Flame Hardening Improves Fatigue Strength by 50%.** O. J. Horger. *Industry and Welding,* v. 19, June '46, p. 52-53, 68.

Discusses the setup, unit and procedure.

18-153. **The Temperature Range of Martensite Formation.** R. A. Grange and H. M. Stewart. *Metals Technology,* v. 13, June '46, T. P. 1996, 24 p.

Study of martensite formation in 14 carbon and low-alloy steels. Resultant data may be directly used for selecting the lowest quenching temperature at which no martensite will form; for selecting the highest quenching temperature at which virtually all martensite will form, thereby avoiding quenching to an unnecessarily lower temperature with attendant danger of cracking; and in producing a mixture of tempered martensite and bainite, which in high-carbon steels has been found to possess somewhat better ductility than tempered martensite, yet does not require the full transformation time necessary for a completely bainitic (austempered) structure. 11 ref.

18-154. **The Relationship Between Transformation at Constant Temperature and Transformation During Cooling.** G. K. Manning and C. H. Lorig. *Metals Technology,* v. 13, June '46, T. P. 2014, 22 p.

Relationship between beginning transformation during cooling and beginning transformation at constant temperature of five 0.30% carbon alloy steels of various chromium contents was studied. Specimens of two of five steels were quenched in two temperature steps rather than the single step commonly used in studying isothermal transformation. From the Ae_3 temperature down to about 1130° F. the time required for beginning isothermal transformation at that temperature may be regarded as a fraction of the nucleation period, and when the sum of such fractions equals one nucleation begins. Concept may be used as the basis of a mathematical expression that permits calculation of the temperature at which transformation begins during cooling.

18-155. **Factors for the Calculation of Hardenability.** Irvin R. Kramer, Sidney Siegel, and J. Gardner Brooks. *Metals Technology,* v. 13, June '46, T. P. 2029, 28 p.

Steels used and methods of investigation; determination of the factor curves for carbon; details of determination of ideal critical diameter for low-hardenability steels; discussion of results.

18-156. **Gas Carburizing.** *Iron and Steel,* v. 19, June '46, p. 387-388.

Self-contained installation using town gas.

18-157. **Induction Hardening Speeds up Lead-Screw Production.** Charles H. Parks and Joseph Libsch. *Machinery,* v. 52, July '46, p. 179-182.

By substituting localized hardening of the finished lead-screw thread for through hardening of the lead-screw bar, elongation and distortion were greatly decreased and grinding time was reduced by more than half.

18-158. **Gas Carburizing.** Ivor Jenkins. *Iron and Steel Institute Advance Copy,* June '46, 21 p.

The mechanism of carburization in solid and in gaseous media is discussed, and it is shown that in pack carburizing the atmosphere surrounding the work is rich in carbon monoxide and hydrogen. The hydrogen plays an active role in the basic carburizing reactions, possibly by forming hydrocarbon gases which carburize the steel or by promoting the removal of surface films of carbon dioxide.

18-159. **Carbon Rod Rectification.** Stewart M. DePoy. *Steel,* v. 119, July 15, '46, p. 114-116.

Treatment of steel salt baths prevents decarburization of work, eliminates sludge, and prolongs life of bath and electrodes.

18-160. **Quenching-Water Requirements of Induction Heated Parts.** B. R. Miller. *Mechanical Engineering,* v. 68, July '46, p. 617-618.

Test has brought to the fore the fact that quenching water pressure, volume, and the quench fixture itself are the three major items that determine the effectiveness of the quench.

18-161. **Problems in High Frequency Induction Heating.** E. H. Hulse. *Iron Age,* v. 158, July 18, '46, p. 60-64.

Simplified formulas for performing calculations on size of induction coils, and general information on induction heating.

18-162. **Effect of Water Vapor on Magnesium Alloys During Heat Treatment.** R. F. Thomson, D. B. Burks, and W. E. Jominy. *Metal Progress,* v. 50, July '46, p. 67-71.

In the solution treatment at 720 to 730° F. of magnesium alloys containing 6% aluminum and 3% zinc, an apparently anomalous behavior is occasionally encountered in the susceptibility of this alloy to "heat treat burning". This is ascribed to water vapor in the furnace atmosphere, and can be inhibited by SO_2 in amounts as small as 0.6%. Heat treating at 715° F. appears to prevent burning even in the presence of appreciable quantities of water vapor, but solution of beta compound is not as complete as after heating at 730° F.

18-163. **Influence of Heat Treatment Upon the Susceptibility to Graphitization of High Aluminum Deoxidized Carbon-Molybdenum Steel.** F. Eberle. *Welding Journal,* v. 25, May '46, p. 307s-312s.

Experiments show that normalized material is slightly less susceptible to graphitization than annealed material; normalizing at temperatures close to the A_3 point offers a better safeguard than normalizing at very high temperatures; welding conditions should be chosen so as to minimize strain in the weld-affected metal by suitable preheating; long-time stress relieving at 1300° F. is more advantageous as a safeguard against graphitization than conventional stress relieving at 1200° F.

18-164. **The Effect of Stabilizing and Stress Relief Heat Treatment Upon Welded 18-8 Stainless Steel.** Wilson G. Hubbell. *Western Metals,* v. 4, July '46, p. 19-22.

Results of tests designed to determine particular benefits, if any, which might be imparted by these processes to 18-8 type 321 and type 347 stainless steels for use on exhaust manifolds.

18-165. **Gas Carburizing.** *Aircraft Engineering,* v. 18, June '46, p. 213-214.

A description of the fundamentals and equipment for gas carburizing as a controlled atmosphere system for the protection of surface finish.

18-166. **Salt Bath for Heat Treating Stabilized Stainless Steel.** Keith Whitcomb. *Automotive and Aviation Industries,* v. 95, July 15, '46, p. 36-39.

Samples of salts operating between 1650 and 2000° F. heated to a temperature of 1750° F. in either an Inconel or stainless steel pot by means of a circular gas-fired furnace. Samples of stainless steel then immersed in the salts for varying lengths of time and either quenched in water or allowed to cool in air. Some samples were pickled and others were not. General properties of each salt such as fuming tendencies, mobility and sludge formation were observed.

18-167. **Practical Phases of Applying High-Speed Direct Gas Heating.** Frederic O. Hess. *Industrial Heating,* v. 8. July '46, p. 1122-1136.

Justification for consideration of the use of high-speed direct gas heating techniques in industrial operations is offered. Numerous successful practical applications of high-speed direct gas-fired heating and heat treating units are shown and described.

18-168. **Aluminum Forging and Heat Treating Furnaces at Alcoa New Castle Works. Part II.** *Industrial Heating,* v. 8, July '46, p. 1143-1148.

Special heat treating department in which all of the dies used in the forging presses are heat treated after sinking in the plant's own large and completely equipped die shop.

18-169. **The Effect of the Composition of Magnesium Alloys on Their Amenability to Heat Treatment.** L. W. Eastwood and James A. Davis. *Light Metal Age,* v. 5, July '46, p. 8-11, 16.

How temperature and duration of heat treatment should be adjusted to composition of magnesium alloy in question in order to obtain best results and, in some cases, prevent actual damage.

18-170. **Gas Carburizing.** P. F. Hancock. *Machinery (London),* v. 69, July 4, '46, p. 1-8.

Requirements of satisfactory gas carburizing; furnace requirements; furnace types; rotary-drum batch furnaces; continuous furnaces; gas carburizing costs; advantages of gas carburizing.

18-171. **The Growing Use of Prepared Atmospheres.** E. G. de Coriolis. *Industrial Gas,* v. 25, July '46, p. 10-11, 24-25.

Production of prepared atmospheres is in range of tens of millions of cubic feet per day. Single installations of the special equipment usually required for atmosphere generation range in size up to capacities of more than 2.5 million cu.ft. per day. Single generators are now made which produce from 250 to 25,000 cu. ft. per hour of certain types of atmospheres.

18-172. **Something New—Interrupted Quenching.** Carl H. Lekberg. *Industrial Gas,* v. 25, July '46, p. 12-14, 27-29.

Brief outline of the metallurgy of steel; methods for heat treating steel that have been developed incorporating the use of interrupted quenching.

18-173. **Rectification of High-Temperature Salt Baths.** Robert S. Burpo, Jr. *Materials & Methods,* v. 24, July '46, p. 109-111.

Examples show that use of graphite-rod rectified salt baths for hardening of toolsteels results in uniformly clean work, free from decarburization and from scale or discoloration.

18-174. **Heat Treatment of Aluminum Alloy Castings.** E. Carrington. *Light Metals,* v. 9, July '46, p. 336-342.

Elementary discussion on theory and practice of heat treatment of aluminum alloys. Particular attention is paid to various forms of furnaces available, to their operation, and to factors governing the selection of any given type.

18-175. **Heat Treatment of Heavy Cast Steel Sections.** Philip C. Rosenthal and G. K. Manning. *Foundry,* v. 74, Aug. '46, p. 70-75.

Problems arising in attempts to harden heavy cast steel sections completely. Heating and cooling rates of heavy plate; hardenability tests; isothermal diagrams; factors limiting useful amount of alloy; how detrimental is bainite? 2 ref.

18-176. **Salt Bath for Heat Treating 18-8.** Keith Whitcomb. *Metal Progress,* v. 50, Aug. '46, p. 294-298.

Experience with pure barium chloride with added compounds; also pure sodium carbonate. Latter found to act as safe treating medium without rectification or any of the disadvantages of barium chloride. Has reduced number of steps in the annealing and flux removing processes from four to only two. Time required for procedure has been cut from 59 min. to 15 min., accompanied by an over-all saving of about $100,000 per year in this particular part of the manufacturing routine.

18-177. **Freeze Fitting of Auto Parts.** *Steel,* v. 119, Aug. 12, '46, p. 96, 98, 100, 103-104.

Mechanical refrigeration used in assembly line to shrink cylinder block valve inserts 0.002 in. at —120° F.

18-178. **Induction Heating Applications in the Machine-Building Industries.** Harold A. Strickland, Jr. *Machinery,* v. 52, Aug. '46, p. 181-184.

Abstract of comprehensive review of the application of induction heating to processes in the metals industries. Principles involved; high frequencies; coils used for induction heating; applications; static and progressive heat treatments; stresses produced by induction heating; through hardening; induction heating for brazing; for forging; heating equipment for forging.

18-179. **Salts Baths in the Wire Industry.** Herbert H. Schneider. *Wire and Wire Products,* v. 21, Aug. '46, p. 593-596, 615-620, 635.

Study of salt bath heat treatment for wire and wire products; determination of profitable methods.

18-180. **Aging Heat Treatments of 75 S Aluminum.** *Iron Age,* v. 158, Aug. 15, '46, p. 49.

Continuous, interrupted and progressive aging treatments. Recommends their selection be evaluated on fol-

lowing criteria: form of material being processed; cost including furnace time for the process; fabrication methods used; adaptability of the process to the work schedule; physical properties required in the finished product.

18-181. **The Subzero Treatment of High Speed Steel, With Special Reference to Intermittent Cutting.** K. J. B. Wolfe. *Metal Treatment,* v. 13, Summer '46, p. 79-94, 98.

Changes which occur in austenized high speed steels of the 18-4-1, 6-6 and 22-4-1 + 10% cobalt steel varieties, as a result of tempering at 580° C., subzero treatment at −76° C. and combinations of the two have been studied by micro-examination, hardness tests, and magnetic analysis. Steels require two to four temperings at 580° C. to complete the austenite-martensite inversion. Subzero treatment at −76° C. produces similar physical change, but of smaller magnitude than does tempering. Tests carried out with these three steels machining a "40" carbon steel to specification En.8 and a Ni-Cr-Mo steel to specification En.27, under conditions involving intermittent cutting. Maximum cutting efficiency of each steel is dependent on complete austenite-martensite inversion. 11 ref.

18-182. **Heat Treatment and Heat Transfer.** L. Rotherham. *Metal Treatment,* v. 13, Summer '46, p. 135-140.

Account of factors involved in heating and cooling masses of steel of different sizes and of the relations between cooling conditions and the transformations in steel.

18-183. **Heat Treating Aluminum. Part I.** G. W. Birdsall. *Steel,* v. 119, Aug. 19, '46, p. 98-99, 156, 159, 162.

Metallurgy and heat treatment of aluminum alloys in nontechnical terms. Annealing; differential freezing; precipitation; segregation; homogenizing.

18-184. **Effect of Undissolved Carbides on Hardenability.** R. J. Hafsten. *Steel,* v. 119, Aug. 19, '46, p. 112, 114.

Best results in heat treatment are obtained only if austenite composition is given careful consideration. If attainment of this ideal induces prohibitive costs, then use of higher alloy content steels is warranted.

18-185. **Quenching Action in Relation to Cross Section.** W. Eilender, H. Arend and R. Mintrop. *Engineers' Digest,* v. 3, July '46, p. 353-354.

A method for numerical determination of quenching media, in which a silver sphere is quenched in the medium to be investigated and the cooling speed at the core, in relation to the temperature, is measured. (Abstracted from *Fertigungstechnik,* no. 8, Aug. '44, p. 208-212.)

18-186. **Heat Treating Aluminum. Part 2.** G. W. Birdsall. *Steel,* v. 119, Aug. 26, '46, p. 78-79, 127-128, 130-131.

A nontechnical explanation of the physical metallurgy involved during heat treatment.

18-187. **Notes on the Process of Gaseous Malleableizing With Especial Reference to the Use of Steam.** D. M. Dovey. *Foundry Trade Journal,* v. 79, Aug. 1, '46, p. 347-351.

Discusses the various atmospheres used, with main emphasis on use of steam to maintain the desired decarburizing atmosphere. Experiments resulted in recommen-

dations concerning rate of steam addition for different weights, shapes, and sizes of metal pieces to be treated.

18-188. **Cast Aluminum Alloys—Heat Treatment.** H. J. Rowe and W. E. Sicha. *American Foundryman,* v. 10, Aug. '46, p. 30-41.

Process and fundamentals; structural and property changes produced in aluminum alloys by commercial heat treatment.

18-189. **Heat Treatment of Steel Castings.** *American Foundryman,* v. 10, Aug. '46, p. 42-43.

Summarizes developments in the field of heat treatment and gives results of a survey to determine the acceptance by the foundry industry of the end quench test for hardenability.

18-190. **Salt Baths.** F. P. Golby. *Metal Industry,* v. 69, Aug. 9, '46, p. 113-115.

In the heat treatment of magnesium alloys the use of fused chromate compounds means that the risk of dermatitis is always present, especially when the salt baths are being emptied. Describes a method by which this process may be carried out without undue risk.

18-191. **Gas Carburizing.** *Machinery (London),* v. 69, Aug. 8, '46, p. 171-174.

Advantages of the system; general outline of system; carrier-gas preparation plant.

18-192. **Heating and Cooling of Wire.** L. Sanderson. *British Steelmaker,* v. 12, Aug. '46, p. 400-404.

Chart outlines factors governing uniformity in heat treating of wire. General recommendations are given.

18-193. **Induction Heating.** Edwin Laird Cady. *Materials & Methods,* v. 24, Aug. '46, p. 399-410.

Points out where, why and how induction heating is applied. Numerous examples illustrate both typical and unusual applications of induction heating for hardening, brazing, soldering and other types of tasks.

18-194. **Heat Treating Aluminum.** O. L. Mitchell. *Steel,* v. 119, Sept. 2, '46, p. 102-104, 106, 108.

Metallurgical factors which should be observed by plants heat treating aluminum.

18-195. **Effect of Heat Treatment on Steel Castings.** E. E. Howe. *Foundry,* v. 74, Sept. '46, p. 98-99, 194-195, 198-200, 202, 204, 206.

Basic principles of heat treating. Explanation of what happens when steel castings are heat treated and the benefits to be derived from such operations in the way of improved physical properties.

18-196. **Hardenability Test for Quenched and Tempered Steel.** E. J. Wellauer. *Iron Age,* v. 158, Sept. 5, '46, p. 62-66.

Practical application and interpretation of the end quench test from the standpoint of forged and cast steels in the quenched and tempered condition. Test data showing the relationship between tempered hardness and quenched hardness, as a function of hardenability.

18-197. **Temper Embrittlement of Aircraft Steels.** P. A. Haythorne. *Iron Age,* v. 158, Aug. 29, '46, p. 51-55.

Data concerning the effects of tempering temperatures on the impact properties of several aircraft steels. Results of Charpy, Izod, and tension impact tests are illustrated by correlated curves which indicate the variation in degree of embrittlement of susceptible steels when tempered in critical temperature ranges. Application of these data to design and process specifications is briefly discussed, as is also the need for modification of present specifications which attempt to specify a "universal" minimum tempering temperature.

18-198. **Control of Internal Stresses in Heat Treated Aluminum Alloy Parts.** L. E. Benson. *Journal of the Institute of Metals,* v. 72, July '46, p. 501-510.

Serious internal stresses may develop in aluminum alloy parts on quenching after solution treatment. For alloy D.T.D. 410 such stresses are unaffected by subsequent precipitation hardening. Two methods of minimizing the final stresses are compared, and data are given regarding the physical properties of the alloy.

18-199. **Heat Treating Stainless Steel.** H. Seymour. *Industrial Chemist,* v. 32, Aug. '46, p. 483-487.

Discusses technology with reference to oxide films; carburization; quenching temperature; quenching technique; annealing; stabilized alloys; nitriding; sandblasting.

18-200. **Heat Treating Aluminum. Part 4.** O. L. Mitchell. *Steel,* v. 119, Sept. 9, '46, p. 118-120, 122, 124, 126.

Annealing practices and cycles; difficulties and their causes.

18-201. **Heat Treating Techniques Increase Production at Auto-Soler Co.** G. E. Stedman. *Steel Processing,* v. 32, Aug. '46, p. 519-521.

Some details of equipment.

18-202. **Subsurface Hardshells.** *Industrial and Engineering Chemistry (Industrial Edition),* v. 38, Sept. '46, p. 5, 8.

New Russian development in heat treating of steel: high frequency surface tempering with immersion of steel and inducter in water for cooling. Technique permits use of frequency process for treating inner surfaces and intricate parts.

18-203. **Heat Tfeating Aluminum. (Concluded.)** O. L. Mitchell. *Steel,* v. 119, Sept. 16, '46, p. 103-104, 106, 148-149.

Additional heat treating cycles and practices are described. Equipment, heating mediums, temperature controls also discussed.

18-204. **The Influence of the Melting Technique and Heat Treatment on Cracking Resistance of Welded Sheet Steel Containing About 1% Mn.** W. Eilender, H. Arend, and I. Mercea. *Welding Journal,* v. 25, Sept. '46, p. 531s-533s.

Welding of high carbon steel, especially in the form of sheet about 0.04 in. thick, resulted in crack formation near the weld. Causes of cracking found to be primarily chemical composition and melting technique. Austenitic grain size, melting temperature, and nature of heat treat-

ment were also important. Influence of last 3 factors studied as function of carbon content. Results shown graphically and in tables. (Abstracted by D. Rosenthal from *Stahl und Eisen,* v. 63, Oct. 28, 1943, p. 784.)

18-205. **A Critical Survey of Controlled Atmospheres. Part I.** Edward J. Funk, Jr., and Davidlee Von Ludwig. *Iron Age,* v. 158, Sept. 19, '46, p. 42-47.

Controlled atmospheres for various heat treatments of ferrous and nonferrous metals and alloys are evaluated from the standpoints of economics and metallurgy. Suggests a code system whereby the base atmospheres and their modifications can be readily and systematically identified.

18-206. **Fuel Fired Techniques and Their Possibilities.** Frederic O. Hess. *Gas Times,* v. 48, Aug. 17, '46, p. 4-6.

Experiments determined heating rates of billets of diferent metals by means of center and surface thermocouple. Curves are shown. Application of differential heating to surface hardening of steel. Suggests field for further work on technique of high-speed gas heating in metal processing.

18-207. **A Critical Survey of Controlled Atmospheres. Part 2.** Edward J. Funk, Jr., and Davidlee Von Ludwig. *Iron Age,* v. 158, Sept. 26, '46, p. 74-79.

Basing their arguments on the basic chemical reactions which occur when controlled atmospheres are used, the authors take issue with some popular present-day concepts regarding functions of controlled atmospheres. A theory attempting to set forth the probable mechanics of soot formation is proposed, based on isotopic modifications of carbon. Detailed discussion of the effect of hydrogen is also presented.

18-208. **Effect of Heat Treatment on Corrosion Resistance. Part III. Heating and Quenching of Large Stainless Castings.** *Alloy Casting Bulletin,* no. 8, Aug. '46, p. 1-5.

Structures obtained by quenching two large cylindrical castings are related to the cooling rates observed at various depths below the surface. Relationship between these structures and the corrosion rates of the alloys as measured by the 65% boiling nitric acid test is also shown.

18-209. **Timken-Detroit Axle Co. Installs Modern Heat Treating Equipment.** A. P. Tosi. *Steel Processing,* v. 32, Sept. '46, p. 587-592.

Heat treatment of rear axle parts, comprising worm drive units, differential gears, axle shafts and allied minor parts, only discussed as typical examples of latest practices in the main heat treat building.

18-210. **Heat Treatment of Gray Cast Iron for Relief of Internal Stresses.** P. A. Russell. *Foundry Trade Journal,* v. 80, Sept. 5, '46, p. 3-9.

Series of experiments devised to ascertain the amount of relief of internal stress by heat treatment in the range of 400 to 600° C. and at the same time to study the effect on the physical properties. Irons studied were all high-duty cast irons. Effects of exposing specimens to atmos-

pheric weathering and to prior machining were also investigated.

18-211. **Dies Harden in Passing.** J. A. Schaffer. *American Machinist,* v. 90, Oct. 10, '46, p. 101-103.

High-frequency induction heating machine, made especially for progressively hardening press-brake forming dies, has a work-traversing carriage whose speed is electronically controlled to insure uniform depth of hardening for the full length of the die. Traverse rate is selected to suit the contour of the die and the surface area to be hardened.

18-212. **A Critical Survey of Controlled Atmospheres. (Concluded.)** Edward J. Funk, Jr., and Davidlee Von Ludwig. *Iron Age,* v. 158, Oct. 3, '46, p. 50-54.

Effects of Dalton's law of partial pressures and the laws of valence on the chemical equilibrium reactions which occur in all heat treating controlled atmospheres. Complexities of the equilibrium function in rebalancing the atmosphere. 33 ref.

18-213. **Bright Hardening.** C. E. Peck. *Machinery (London),* v. 69, Sept. 12, '46, p. 321-326.

Types of atmospheres suitable for bright hardening, their composition and cost; equipment for producing these atmospheres, with methods and equipment for evaluating the metallurgical effect of the atmosphere on the material being heat treated.

18-214. **Induction Heating.** Russell A. Neilson. *Iron and Steel,* v. 19, Sept. '46, p. 537-539.

Discusses effect of frequency. Fundamental treatment of questions of frequency and capacity of plant.

18-215. **Automatic Machines Use Gas to Heat Treat Parts.** Fred Maud. *American Machinist,* v. 90, Sept. 26, '46, p. 101-106.

Gas is a controllable economical heating medium for performing the following operations on an automatic basis: soft soldering, silver soldering, hardening, hardening combined with drawing, annealing, and heating of billets or bar ends for forging. Cites important factors of the heating cycle, all of which are subject to accurate control. Describes two distinct types of burners necessary for rapid heating techniques possible with automatic machines. Gives some examples of the high heating rates possible and discusses basic types of gas heat treating machines.

18-216. **Modern Methods in the Heat Treatment of Steel.** E. R. Mertz. *Transactions of the American Society of Mechanical Engineers,* v. 68, Aug. '46, p. 637-642.

Construction of time-temperature-transformation curves (S-curves) and their use in developing the interrupted quench processes for steels. Martempering, austempering, and cyclic annealing are explained in detail. Use of hardenability curves in establishing size limitations for particular heats of steel and in selecting accurate tempering temperature.

18-217. **Gas Carburizing.** Ivor Jenkins. *Metallurgia,* v. 34, Aug. '46, p. 199-204.

Results of an investigation which has been carried out over a period of years at General Electric Co., Ltd., into the development of industrial carburizing atmospheres. Carburization of iron and steel in solid and in gaseous media. (Paper for Iron and Steel Institute.)

18-218. **Induction and Dielectric Heating.** *Metallurgia,* v. 34, Aug. '46, p. 210-212.

Brief reference is made to each form and to their fields of usefulness in industry. 4 ref.

18-219. **Some Users' Experience With Lithium Atmospheres for Heat Treating.** Robert S. Burpo, Jr. *Materials & Methods,* v. 24, Sept. '46, p. 622-625.

Several users of lithium protective furnace atmospheres report them a sure and economical way to prevent scaling and surface decarburization.

18-220. **Heat Treatment and Stabilization of High-Carbon Stainless Steels.** H. E. Boyer and H. C. Miller. *Materials & Methods,* v. 24, Sept. '46, p. 637-641.

Results of exhaustive tests on type 440C stainless steel to determine proper heating, cooling and low temperature treatments.

18-221. **Gas Carburizing. Part I.** Ivor Jenkins. *Engineering,* v. 162, Sept. 13, '46, p. 260-264.

Three representative casehardening steels were carburized in bar and plate form in an experimental tube furnace. Carburizing properties of two types of atmospheres (low and high in hydrocarbons) were investigated. Study was made of effect of dilution with inert atmospheres. Degree of carburization was determined by weight increase, by chemical analysis, by metallographic inspection, and by depth-hardness measurements. Details of procedures, results, and conclusions. (Paper for Iron and Steel Institute.)

18-222. **Electric Furnaces for Tool Heat Treatment.** E. F. Watson. *Machinery (London),* v. 69, Sept. 19, '46, p. 361-365.

Electrode-type salt-bath method; high speed steel tools; recommendations for the heat treatment of high speed steel in salt baths.

18-223. **Influence of Heat Treatment Upon the Susceptibility to Graphitization of High-Aluminum-Deoxidized Carbon-Molybdenum Steel.** F. Eberle. *Transactions of the American Society of Mechanical Engineers,* v. 68, Aug. '46, p. 625-630.

Susceptibility to graphitization of carbon-molybdenum steels may be influenced by heat treatment of the material prior to installation. Tests are reported on high-aluminum-deoxidized pipe with welded upset ends, the upsetting being carried out at 2000° F. without subsequent heat treatment. Graphitization in certain zones of the pipe was in evidence. Subsequently the influence of prior heat treatment or weld heat effects upon susceptibility to graphitization was explored.

18-224. **Gas Carburizing. (Concluded.)** Ivor Jenkins. *Engineering,* v. 162, Sept. 20, '46, p. 285-287.

The effect of various atmospheres readily producible from "town gas" on the carburization process was inves-

tigated. The experiments were also run at different temperatures, to investigate its influence on phase changes. A number of photomicrographs illustrate the results obtained. Some information relative to the relationship between the respective activities of solid carbon and of cementite in a saturated solution of austenite has been obtained. (Paper for Iron and Steel Institute.)

18-225. **Effect of Tempering on Mechanical Properties. Part I.** G. K. Manning and G. P. Krumlauf. *Iron Age,* v. 158, Oct. 24, '46, p. 44-50.

Quantitative data to show that wide variations in tempering practice have no effect on the relationship between Brinell hardness and tensile strength, yield point, elongation and reduction of area. Table lists chemical compositions of six steels tested.

18-226. **End-Quench Hardenability Versus Hardness of Quenched Rounds.** George K. Manning. *Metal Progress,* v. 50, Oct. '46, p. 647-652.

Hardness of a number of quenched rounds compared with end-quench hardenability of the same steels to explore possibility that some factor other than cooling rate and chemical composition may affect the hardness and microstructure of quenched steel. Hardness of a round cannot be accurately predicted from a knowledge of end-quenched hardenability data and cooling rates. An arbitrary correlation may be made, but even this is unreliable if the steel composition is decidedly changed. Stresses caused by allotropic transformation and thermal gradients during quenching are the probable reason.

18-227. **Maximum Carbon in Gas Carburizing.** Gerard H. Boss. *Metal Progress,* v. 50, Oct. '46, p. 657-658.

Investigation of powdered iron compacts in a carburizing medium to determine why very thin sections will sometimes carburize to extraordinarily high carbon concentration. Sintering temperatures used were 2050° F., just below the melting temperature of the iron, iron carbide eutectic (ledeburite), and 2200° F.

18-228. **Liquid Carburizing.** R. S. Komarnitsky. *Metal Progress,* v. 50, Oct. '46, p. 665-669.

Operating ranges of baths and time-penetration data. Control and operation; equipment and fixtures.

18-229. **Heating and Surface Hardening of Tools by High Frequency Induction.** *Engineers' Digest (American Edition),* v. 3, Sept. '46, p. 444-446.

Rolling of small high speed steel sections is done by means of a specialized rolling machine designed to eliminate uneven heating which results in cracks. A high-frequency induction coil placed immediately at the entrance of the rolls gives even heating and exact temperature control. Repair of worn ring gages by heat shrinkage is effected by placing them inside an induction coil, heating and oil quenching. Brazing of hard tips on cutters is by means of rectangular shaped coils. Surface hardening of taps and high speed tools is done by rotating them inside the coil and dropping into an oil bath when desired temperature is reached. (Condensed from *Promishlennaya Energetica,* 1946, p. 3-14.)

18-230. **Annealing Rate in Gaseous Malleableizing.** D. M. Dovey and I. Jenkins. *Foundry Trade Journal,* v. 80, Sept. 19, '46, p. 63-68.

Establishment of a relationship between maximum section and time of annealing necessary for the required degree of malleability in the production of white-heart malleable from white cast iron is desirable. Difficulties involved in development of such a formula are outlined. However, when controlled atmospheres are used it appears possible to develop a formula relating time of annealing, mean residual carbon content of product and thickness of coating. Discusses the application of diffusion laws to decarburization, and points out interfering factors. Values attained by use of a diffusion equation are plotted and their validity discussed; also presents empirical curves showing relationship between thickness of casting, time of anneal, and mean residual carbon content.

18-231. **How to Build a Charcoal Preheating Furnace.** *Welding Engineer,* v. 31, Oct. '46, p. 50-51.

Simple instructions for erection.

18-232. **Modern Methods for Interrupted Quenching.** Carl H. Lekberg. *Industrial Heating,* v. 13, Oct. '46, p. 1591, 1592, 1594, 1596, 1598, 1600, 1602.

Discusses briefly metallurgy of steel and methods of heat treating steel that have been developed, incorporating the use of interrupted quenching.

18-233. **New Annealing Plant for Steel Strip in Coils at the Whitehead Iron and Steel Co., Ltd., Newport, Mon.** B. Jones and I. Jenkins. *Iron and Steel Institute Advance Copy,* Sept. '46, 13 p.

Describes an electric unit for the annealing of steel strip in coils in a controlled atmosphere. Details of annealing cycle are given, and causes of staining of the steel charge by unsuitable annealing gas and rolling oils. Tests made on the properties of low-carbon steel strip annealed in various parts of the annealing container, and effect of annealing temperature on the properties of heavily cold-reduced mild steel strip given. Shows that there is a range of annealing temperatures above 600° C. in which the work-hardening effects are effectively removed, good properties are obtained, and a suitable grain size can be imparted to the steel.

18-234. **Induction Methods of Heat Treating.** R. W. Dexter. *Western Metals,* v. 4, Oct. '46, p. 63-66.

Some of the methods and results that can be expected from the use of induction equipment.

18-235. **The Tempering of High-Alloy Toolsteels.** George A. Roberts, Arthur H. Grobe, and Christian F. Moersch, Jr. *American Society for Metals Preprint,* no. 9, 1946, 27 p.

Complete tempering data are reported for eight high-alloy toolsteels, for the range of 200 to 1300° F. and 0.1 to 100 hr. At least four quenching temperatures were used for each steel Also a limited amount of tempering data is used, but Hollomon and Jaffe's method was considered the best to present all of the tempering data for one steel from one quenching temperature on a single curve. Effect

of quenching temperature upon the quenched hardness of the eight steels is also discussed.

18-236. **Changes in Size and Toughness of High-Carbon, High-Chromium Steels Due to Subzero Treatments.** L. E. Gippert and G. M. Butler, Jr. *American Society for Metals Preprint,* no. 10, 1946, 10 p.

Three types of high-carbon, high-chromium die steels are shown to expand considerably when given a subzero treatment after hardening before tempering. Hardnesses of Rockwell C-47 to 68 are developed. Holding at room temperature for 24 hr. before cold treatment at 300° F. almost entirely nullified the effect of subsequent cold treatment. Izod impact tests revealed no excessive brittleness when allowance was made for the increased hardness.

18-237. **Carbon Concentration Control.** E. G. de Coriolis, O. E. Cullen, and Jack Huebler. *American Society for Metals Preprint,* no. 14, 1946, 24 p.

Phase rule is applied to all the possible gas compositions which might be used in gas carburizing, and from the results obtained the most suitable compositions and variations for commercial purposes are determined. Effects of these compositions on the steel are then developed using the conventional iron-carbon diagram as a basis. Necessary carbon potential, its effect upon steel of varying initial carbon content, its limitations as to range of action, and other interrelationships between the gas and metal are then brought out.

18-238. **Development of Temper Brittleness in Alloy Steels.** W. S. Pellini and B. R. Queneau. *American Society for Metals Preprint,* no. 16, 1946, 16 p.

Development of temper brittleness studied in two steels of different hardenability. Effect of time at temperature in the temper-brittle range has been determined and these results have been compared with the embrittlement developed in the steels while cooling or heating through the same range of temperatures. In addition, the effect of microstructure on the development of temper brittleness has been determined for one of the steels.

18-239. **The Interrupted Quench and Its Practical Aspects.** Howard E. Boyer. *American Society for Metals Preprint,* no. 20, 1946, 18 p.

Treatise on the interrupted quench only and does not in any way deal with isothermal transformation. Work on tempering the alloy carburizing steels is briefly reviewed though principal attention is given to the results of development work which has been done on the higher carbon low-alloy steels. S.A.E. 52100 ball bearing type steel was selected for study after it was found to give results somewhat adverse to those which might be logically expected from the martempering practice.

18-240. **Relation of Quenching Rate and Hardenability to the Mechanical Properties of Several Heat Treated Cast Alloy Steels.** Charles R. Wilks, Howard S. Avery, and Earnshaw Cook. *American Society for Metals Preprint,* no. 28, 1946, 34 p.

Tensile and impact properties have been determined with the latter appearing to be more sensitive to structural differences. It is suggested that, for cast steels, accentuated intercellular segregation militates against increased alloying for heavier sections. Optimum mechanical properties seem to be coincident with the minimum hardenability which will produce maximum hardening for any particular rate of cooling.

18-241. **Effect of Tempering on Mechanical Properties. Part II.** G. K. Manning and G. P. Krumlauf. *Iron Age,* v. 158, Oct. 31, '46, p. 50-55.

Correlation found to exist between Charpy impact values and Brinell hardness, at room temperature, −40, and −80° F. is presented. Results of extensive tests conducted to determine the effect of tempering practice on the relationship between these properties, and also of the influence of steels susceptible to temper brittleness on such correlation.

18-242. **Induction Heating Applied to Steel Gears.** T. H. Gray. *Materials & Methods,* v. 24, Oct. '46, p. 915-918.

Several examples of how induction heating is advantageously applied to gearing to speed output and reduce finishing costs

18-243. **Form Tools.** William F. Walker. *Edgar Allen News,* v. 25, Oct. '46, p. 696-699.

Molybdenum toolsteel; manipulation and heat treatment; forging; annealing; hardening; tempering or secondary hardening; salt bath hardening; cold treatment; and cemented carbide tools. (To be continued.)

18-244. **"Portable" Induction Heating.** *Steel,* v. 119, Nov. 11, '46, p. 166, 169, 236.

New method expands applications for induction heating since it permits bringing heat to bulky work and short-run items which cannot be handled readily by standard inductor work coils. Wider range of work also made possible through development of 30,000-cycle and 3-megacycle machines. Variable ratio transformer reduces machine changeover time when switching from job to job.

18-245. **Automatic Induction Hardening of Ford Starter Ring Gears.** Charles O. Herb. *Machinery,* v. 53, Nov. '46, p. 166-169

Application of induction heating process, by which 180 ring gears can be automatically hardened per machine per hour.

18-246. **Salt Baths for Hardening High Speed.** W. E. Bancroft. *Metal Progress,* v. 50, Nov. '46, p. 941-947.

Applications and limitations; equipment and handling methods; time-temperature cycles; operation and maintenance of baths; operating cost data. 9 ref.

18-247. **The Art of Quenching; I—Coolants.** Roy G. Roshong. *Metal Progress,* v. 50, Nov. '46, p. 948-951.

Quenching problems which arise in commercial heat treating shops or the closely related tool and die heat

treating departments of industrial organizations, in contrast to those arising in the treatment of standard production items. Quenching waters and brines, oils, molten baths.

18-248. **Induction Hardening of Armor.** T. Bishop. *Metal Progress,* v. 50, Nov. '46, p. 954-955, 957-958.

Equipment at Dortmund-Hoerder Huttenverein, Hoerde, Ruhr, hardens plates up to 7 ft. wide, 24 ft. long and thickness of 16 in. (and possibly greater) at a rate of the order of 8 in. per min., giving a hardened layer up to 2¾ in. thick. Good results were obtained for thin tank armor, of the order of 1-in. plate, giving ballistic results equal to, if not better than, homogeneous plate against uncapped shot. This advantage was found to decrease, however, as the plates become thicker, until at 4 in. little improvement was obtained.

18-249. **Neutralene Gas Producing Equipment.** A. G. Hotchkiss and H. M. Webber. *General Electric Review,* v. 49, Nov. '46, p. 21-27.

Equipment designed for production of atmospheres for metallurgical use. Fuel gas and air are processed to make a gas whose analysis can be varied over a considerable range.

18-250. **Conveyerized Automatic Heat Treatment.** A. F. Holden. *Iron Age,* v. 158, Nov. 14, '46, p. 70-74.

Problem of obtaining uniformity in metallurgical properties in heat treatment operations is greatly minimized by the use of automatic salt bath conveyer equipment. Describes several types of conveyer mechanisms, associated with particular operations where these types have proven highly successful. Detailed discussion of automatic conveying methods as applied to conventional heat treatment and to martempering is also presented.

18-251. **Heat Treatment of Heavy Cast Steel Sections.** Philip C. Rosenthal and G. K. Manning. *Steel,* v. 119, Nov. 18, '46, p. 88-90, 92, 94, 111.

Problems arising in attempts to harden heavy cast steel sections completely.

18-252. **Carburizing Treatments.** *Steel,* v. 119, Nov. 18, '46, p. 101.

Use of atmosphere composed of cracked gas, natural gas and ammonia on small parts.

18-253. **Heat Treatment of High-Tensile Aluminum Alloy Sheet.** J. G. Gwatkin. *Aircraft Production,* v. 8, Nov. '46, p. 527-528.

Revision of existing methods. Some typical proof and maximum stresses now being obtained by double heat treatment followed by artificial age hardening are shown in table, which includes for comparison some of the better-known naturally aging materials.

18-254. **Induction Hardening in Lead Screw Production.** C. H. Parks and J. Libsch. *Machinery (London),* v. 69, Oct. 17, '46, p. 489-492.

By substituting localized hardening of the finished lead screw thread for through hardening of the lead screw

bar, elongation and distortion are greatly decreased and grinding time is reduced by more than half.

18-255. **A New Approach to the Problem of Protecting Magnesium During Heat Treatment.** Davidlee Von Ludwig. *Industrial Gas,* v. 25, Nov. '46, p. 15-18, 28, 30-34.

Fires in a magnesium alloy heat treating oven are generally caused by too rapid heating, which causes melting and oxidation of the beta phase. In conventional practice, SO_2 is used to suppress oxidation. However, this has a corrosive action. Therefore, direct circulation of fuel gas combustion products is recommended. This process is successfully used by Superior Bearing Bronze Co. in Brooklyn.

18-256. **Relief of Stresses in Steel Products.** *Materials & Methods,* v. 24, Nov. '46, p. 1225.

Some data on the thermal relief of internal stresses in steel castings and wrought steel weldments graphically summarized.

18-257. **A New Heat Treating Atmosphere Producer.** A. G. Hotchkiss and H. M. Webber. *Iron Age,* v. 158, Nov. 21, '46, p. 48-55.

New technique, whereby heat energy formerly wasted is effectively applied in furnishing heat to the gas producing system, has resulted in considerable reductions in cost and space considerations. Newly devised flow charts; various aspects of Neutralene as an effective heat treating atmosphere.

18-258. **Some Aspects of Nitriding.** S. A. J. Sage. *Metallurgia,* v. 34, Oct. '46, p. 299-303.

Nitriding is shown to require extremely careful technique to avoid unexpected variations in the finished material. Some of the problems which arise, and how to solve them. Illustrated by charts and photomicrographs showing effects of variations in treatment techniques.

18-259. **Shortcuts in Spring Manufacture.** Walter F. Whiteman. *Steel,* v. 119, Nov. 25, '46, p. 72-74.

Spring leaves sheared from flat rolled steel are heat treated uniformly, and simultaneously quenched and cambered in semiautomatic furnaces and machines which have increased plant's output 15%.

18-260. **Bright Hardening Stainless Steel.** *Steel,* v. 119, Nov. 25, '46, p. 80, 82.

Bright finish is retained in hardening process using cracked ammonia atmosphere to eliminate moisture and prevent any oxidation of the surface chromium.

18-261. **Hardness and Hardenability.** J. W. Donaldson. *Metal Treatment,* v. 13, Autumn '46, p. 169-181.

Reviews some of the research work carried out in the past few years in the United States. The well-known Jominy test has certain limitations and other tests have been developed which give improved results. Experiments have been made on the effect of prior structure, the effect of the percentage of martensite present and on the hardenability of cast steel of varying composition and grain size. 26 ref.

18-262. **Fundamentals of Annealing Low-Carbon Steel.** G. Sachs, L. J. Ebert, G. B. Kasik, and J. F. Nejedlik. *Iron and Steel Engineer,* v. 23, Nov. '46, p. 88-98.

Results of an extensive experimental study conducted at Case School of Applied Science to obtain a complete picture of the factors which determine the properties of annealed, low-carbon steel strip. Includes effects of cold work; effect of annealing time and temperature; basic hardening effects; and effect of cooling rate. Results are presented graphically.

18-263. **Hardening and Tipping Tools in a Carbon Muffle.** E. F. Watson. *Machinery (London),* v. 69, Oct. 24, '46, p. 517-519.

In operation, the carbon block, supported by a silicon-carbide muffle, is placed in the furnace and brought up to the hardening temperature. The steel to be hardened is placed on a refractory tray inside the carbon block. The air in the block reacts with the carbon to produce the protective atmosphere. Furnace specially built to use the carbon muffles, and assembly of the furnace muffle, carbon muffle and refractory tray are shown.

18-264. **A Discussion of Prepared Furnace Atmospheres.** Charles E. Thomas. *Steel Processing,* v. 32, Nov. '46, p. 733-738.

Applications of various types of special furnace atmospheres. Danger of contamination with air and moisture; use of metallic lithium to nullify the action of oxygen, CO_2 and water vapor.

18-265. **Cast Steel, Homogenization Heat Treatments. Part I.** John G. Kura and Philip C. Rosenthal. *American Foundryman,* v. 10, Nov. '46, p. 22-38.

Effects of homogenizing heat treatments of 2, 6, or 12 hr. at 1650, 1750, 1850, 1950 or 2050° F., and of 12 hr. at 2250° F., on the hardenability and mechanical properties of five hardened and tempered commercial 2-in. cast plates from five different producers were determined. Any deviations that arose were more closely related to position of test pieces in original plate than to influence of homogenizing heat treatment. The various homogenizing treatments produced no appreciable change in the characteristics of the hardened and tempered specimens of these five low-alloy steels.

18-266. **Prepared Atmospheres.** C. C. Eeles, and M. E. Shriner. *Steel,* v. 119, Dec. 2, '46, p. 110-113, 154, 155.

A codification of all prepared furnace atmospheres is presented as an aid in selecting suitable atmospheres for the greatly varied processing of metals.

18-267. **Some Investigations on the Heat Treatment of Sheet Steel for Cold Pressing.** T. Yourtaieff. *Sheet Metal Industries,* v. 23, Nov. '46, p. 2116-2120, 2124.

Experiments include a study of basic bessemer rimming steel sheet as well as a few results on the heat treatment of killed steel deep drawing sheet. Chief problems were rates of heating and cooling, time of soaking, and partial annealing and other special treatments. Final part

of investigation was devoted to tests on the aging of sheets after the heat treatments previously studied. Thus work was limited to rapid cooling speeds. (To be continued.)

18-268. **Internal Stresses in Aluminum Alloy Parts.** L. E. Benson. *Engineering,* v. 162, Nov. 15, '46, p. 463.

Normal heat treatment applied to many aluminum alloys involves quenching and subsequent precipitation hardening. This treatment often sets up internal stresses of dangerous magnitude. Tests were made over a range of temperatures to investigate the possibility of these stresses being relieved by plastic flow during the precipitation hardening treatment. Freedom from internal stress was obtained by quenching in water at 100° C. This process resulted in less sacrifice of strength and elasticity than final stress-relief annealing.

18-269. **Buyer Reluctance Retards Switch to H-Band Steels.** *S.A.E. Journal,* v. 54, Dec. '46, p. 72.

Data show that H-band spreads are actually much closer than hardenability spreads resulting from chemistry specifications—something like 70 to 80% of the chemistry spread. This contention is well illustrated by graph. Reports from users are needed showing benefits already accrued from using H-band steels. Reports should be based on characteristics exhibited during heat treatment, including information on such phases as quenching media, tempering temperature, and cracking.

18-270. **The Nitriding of High Speed Steel Tools in Salt Baths.** E. F. Watson. *Machinery (London),* v. 69, Nov. 21, '46, p. 662.

Advantages of treatment; required temperatures; necessity of avoiding contamination and nonunformity. Times for various tools are shown in table.

18-271. **Gas Cyaniding.** H. M. Parshall. *Steel,* v. 119, Dec. 16, '46, p. 86-88.

Useful method of casehardening, especially for parts made of low-carbon, nonalloyed steels such as S.A.E. 1020 and 1112. Process consists of exposing parts, at proper temperature, to gaseous medium containing carbon and nitrogen.

18-272. **Gas Carburizing.** Ivor Jenkins. *Iron and Steel,* v. 19, Nov. 21, '46, p. 698-708.

Mechanism of carburization; carburization with town gas and with butane; carburization with diluted propane; carburization with carbon monoxide and hydrogen atmospheres; nature of the steel surface and its effect upon the rate of carburization; effect of temperature on carburization.

18-273. **Coiled Strip Annealing.** B. Jones and I. Jenkins. *Iron and Steel,* v. 19, Nov. 21, '46, p. 747-750; discussion, p. 769-770.

New electric annealing plant installed at works of the Whitehead Iron and Steel Co., Ltd., Newport, Mon., England, in 1944, for the bright annealing of cold rolled, mild steel strip in coils. Consists of the vertical cylindrical or batch type furnaces.

18-274. **The Nitriding of Steel.** Carl F. Floe. *Metal Progress,* v. 50, Dec. '46, p. 1212-1220.

Nitriding media; structure of nitride cases; nitriding furnaces; growth in nitriding; protection against nitriding; steels for nitriding; applications of nitriding.

SECTION XIX

WORKING

Rolling, Drawing, Forging, Forming

19-1. **Tooling Possibilities of Plaster of Paris Impregnated with Synthetic Resins.** John Delmonte. *Automotive Industries,* v. 93, Dec. 1, '45, pp. 32-33, 87-88, 90, 94, 96, 98, 102.

Resistant to chipping or breaking, impregnated plaster forms show promise in applications to hydropress work in forming sheet metal, and because of highly polished surface which can be developed, they can be used as stretch press dies. Much of the tooling formerly prepared in cast metals for the automobile industry can now be safely considered in properly treated plaster.

19-2. **The Fabrication of High Strength Steel.** C. E. Loos. *Steel Processing,* v. 31, Dec. '45, pp. 755-759.

Suggests differences in fabrication behavior between U.S.S. Cor-Ten and structural carbon steel.

19-3. **Metal Piercing With the Use of Presses.** *Steel Processing,* v. 31, Dec. '45, pp. 777-778, 784.

Examples cited of application of operation to non-ferrous metals; also applicable to fabrication with ferrous alloys.

19-4. **Rolling of Large Diameter Tubes.** *Machinery (London),* v. 67, Nov. 22, '45, pp. 568-570.

Comparison with earlier methods; control of diameter and wall thickness; discharge, annealing and plastic flow.

19-5. **Extrusion.** W. W. Cotter and W. R. Clark. *Metal Industry,* v. 67, Nov. 23, '45, pp. 338-340.

Production of copper-base alloy plain and tubular sections by extrusion.

19-6. **Krause Mill.** P. M. Mueller. *Iron and Steel,* v. 18, Nov. '45, pp. 487-493.

New principle of reduction applicable to most metals.

19-7. **Modern Machine Tools.** *Aircraft Production,* v. 7, Nov. '45, pp. 553-554.

Combined stretching-detwisting machine.

19-8. **Rolling Mill Guides.** Wade F. Hoffman. *Iron & Steel Engineer,* v. 22, Nov. '45, pp. 69-79, 86.

Some problems in the design and use of guides, concern-

ing which little or nothing has been published. Guide design is not an exact science, but is influenced by varying conditions and requirements.

19-9. **Extrusion.** W. W. Cotter and W. R. Clark. *Metal Industry,* v. 67, Nov. 30, '45, pp. 364-365.

Average results of a number of tests made during commercial operation, mostly on a 2200 to 2750-ton tube press used to extrude rod.

19-10. **"Electro-Forged" Ship Gratings.** Arthur J. Randolph. *Welding Engineer,* v. 30, Dec. '45, pp. 50-51.

"Electro-forging" is done on spot-welding machine but with dies instead of electrodes.

19-11. **"Shimmy" Dies.** John Parina. *Steel,* v. 117, Dec. 24, '45, pp. 76-77, 92.

Straight edge trimming, with or without notches and projections, can be done in one operation on Brehm dies. Variety and sizes handled range from small, round ferrules, and women's gold wrist watch cases to stainless steel beer barrels, ends of burial vaults and electric refrigerator doors.

19-12. **Peen Straighten Steel by Hammering.** *Steel,* v. 117, Dec. 24, '45, p. 96.

With two types of hammers shown, demonstrates that hitting soft, flat piece of steel or iron repeated blows in different spots will result in a series of dents or depressions in metal hammered.

19-13. **Tables of Rolling Pressures and Power Requirements for Rolling Steel Shapes.** *Blast Furnace & Steel Plant,* v. 33, Dec. '45, inset between pp. 1534-1535.

Translated and compiled by F. Waldorf from the German text published by J. Puppe, Düsseldorf, Germany, in 1913, under the auspices of Vereins Deutcher Eisenhütten-leute.

19-14. **Merchant Mill and Alloy Finishing Facilities at Fontana.** R. M. Bickerstaff. *Blast Furnace & Steel Plant,* v. 33, Dec. '45, pp. 1513-1522.

Descriptions and illustrations.

19-15. **Metal Stampings—Sunny Side Up!** Harry W. Krasberg. *Tool & Die Journal,* v. 11, Dec. '45, pp. 86-87, 96.

Portions of toolroom, inspection and press departments evidence versatile equipment, good housekeeping and skilled craftsmanship.

19-16. **Upsetting Cylinder Barrels.** G. W. Birdsall. *Steel,* v. 117, Dec. 31, '45, pp. 52-56.

Cut more than 50% from weight of rough forging by changing over from conventional forging to upsetting method.

19-17. **Zinc Extrusions Attain Commercial Status.** Herbert Chase. *Materials & Methods,* v. 22. Dec '45, pp. 1724-1727.

Rods, tubes, bars and special shapes now being produced of high purity zinc and its alloys.

19-18. **Presses Play Important Role in the Manufacture of Surgical Instruments.** Floyd McKnight. *Modern Industrial Press,* v. 7, Dec. '45, pp. 20, 22, 24.

Forceps and scissors, as well as numerous other surgical instruments, are drop-forged, then machined, milled, filed, trimmed, ground and finished. Considers manufacturing process step by step.

19-19. **Hydraulic Strippers Facilitate Drawing of Thin Shells.** Henry F. Hild. *Machinery,* v. 52, Dec. '45, pp. 147-153.

Ingenious method of removing thin drawn shells from punches without causing damage to workpieces.

19-20. **Aircraft Manufacturing Technique Applied to Bus Building.** R. B. Stubbs. *Machinery,* v. 52, Dec. '45, pp. 168-175.

Kirksite dies and stretch blocks now being employed by Brill Division of the American Car & Foundry Co. for forming contoured bus body sections.

19-21. **Design and Production Technique, IV: Principles Involved in Drawing.** A. J. Schroeder. *Aircraft Engineering,* v. 17, Nov. '45, pp. 331-337.

Thorough discussion of principles involved in drawing of metals, including brass, copper-zinc, aluminum, sheet tin, steel, etc.

19-22. **Cemented Carbide Dies.** *Steel,* v. 117, Dec. 31, '45, p. 72.

Die cost cut 80%.

19-23. **Deep Drawn Work.** *Western Machinery & Steel World,* v. 36, Dec. '45, pp. 559-561.

Suitable selection and arrangement of presses, coupled with increased mechanical handling of parts from one press operation to next, has made possible reduction of annealing operations, stepped up production and reduced costs. Typical examples illustrating possibilities in deep drawing described.

19-24. **Reactive Wire Drawing, Part II.** Janet M. Howden and R. Winstanley Lunt. *Wire Industry,* v. 12, Dec. '45, pp. 641-643, 645.

Outline of the quantitative dependence of the mean pressure between the wire and the die wall on the tension in the wire entering the die. 9 ref.

19-25. **The Rolling of Metals: Theory and Experiment, Part VII.** L. R. Underwood. *Sheet Metal Industries,* v. 22, Dec. '45, pp. 2089-2095.

Factors influencing rolling load and specific roll pressure with special reference to thin sheet and strip rolling.

19-26. **Practical Problems of Light Presswork Production.** J. A. Grainger. *Sheet Metal Industries,* v. 22, Dec. '45, pp. 2111-2118.

Follow-on die work.

19-27. **Precision Form Tools.** G. G. Williams. *Sheet Metal Industries,* v. 22, Dec. '45, pp. 2129-2137.

Power press tools made from wood and tempered strip steel.

19-28. **New Blooming Mill.** G. A. V. Russell and G. W. Fox. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 541-544.

Some design and operating features.

19-29. **Calculating Bend Allowances.** J. B. Clegg. *Sheet Metal Industries,* v. 22, Dec. '45, pp. 2151-2154.

Some theories on effects of various mechanical and

physical conditions prevailing during forming operations, with observations on general practice.

19-30. **The Manufacture of Seamless Steel Tubes.** J. W. Jenkin. *Metallurgia,* v. 33, Dec. '45, pp. 59-64.

Evolution of the barrel piercer; disk piercer; cone piercer; pilger mill; plug rolling; diescher mill; Assel mill; Foren mill; reducing mill; hot drawing; forging.

19-31. **Forming Stainless Steel With Zinc Alloy Dies.** W. W. Broughton. *Metallurgia,* v. 33, Dec. '45, pp. 110-111.

Zinc-copper-aluminum alloy dies are regarded as low-cost dies, useful for moderate production runs. Table gives some of their applications and the number of parts involved in the lot or the number made before failure. These applications show either the thickest gages or the longest runs made with zinc alloy dies.

19-32. **Zinc Extrusions.** L. E. Browne. *Steel,* v. 118, Jan. 14, '46, pp. 96, 130.

Physical properties and processing methods presented for zinc in wide variety of new forms and shapes in which it now is available.

19-33. **Forgings and Stampings, Part I.** J. R. Handforth and J. Towns Robinson. *Metal Industry,* v. 68, Jan. 4, '46, pp. 3-6.

Discusses the plant and methods in use at the present time.

19-34. **Laboratory Evaluation of the Hot Working Characteristics of Metals.** C. L. Clark and J. Russ. *Metals Technology,* v. 12, Dec. '45, T. P. 1839, 13 pp.

Influence of rate of deformation on high temperature properties; hot twist test; results of hot twist tests on typical steels; interpretation of twist test results; application of hot twist data; limitations of the hot twist tests. 5 ref.

19-35. **Production Processes—Their Influence on Design. Part VII. Deep Drawing.** Roger W. Bolz. *Machine Design,* v. 18, Jan. '46, pp. 119-126.

Depth of draw restricted; drawing radii are critical; wide tolerances reduce costs.

19-36. **Metal Spinning Meets a Need.** C. J. Holinger. *Modern Machine Shop,* v. 18, Jan. '46, pp. 124-128, 130, 132.

For a few pieces of a size the process will save enough in tool cost and set-up time to more than make up for the extra cost per piece. In large diameters, no other method can compete in cost. Various operations illustrated and discussed.

19-37. **Greater Speeds and Increased Tonnages to Be Obtained From Mills as Now Designed.** W. R. Duda. *Blast Furnace and Steel Plant,* v. 34, Jan. '46, p. 115-117.

New designs assist the steel and non-ferrous mills in producing better quality products at higher speeds and lower costs. Modern strip mills will be stepped up to speeds 50% greater than those possible before the war. Rod mills and bar mills will be more rugged in design, to take heavier drafts and to roll at higher speeds. Tube

mills, both seamless and butt weld, will be stepped up to deliver products at speeds up to 30% greater. Increased production to cut manufacturing costs.

19-38. Output of Rolling Mills and Auxiliary Equipment Increased by Electrical Developments. F. Mohler. *Blast Furnace and Steel Plant,* v. 34, Jan. '46, p. 118-120.

Cold reduction mills; processing equipment; hot strip mills; rod mills; tube mills; draw benches; load-swing control.

19-39. Tables of Rolling Pressures and Power Requirements for Rolling Steel Shapes. *Blast Furnace and Steel Plant,* v. 34, Jan. '46, p. 130 and inset.

Translated and compiled by F. Waldorf from the German text published by J. Puppe, Düsseldorf, Germany, in 1913, under the auspices of Vereins Deutcher Eisenhütten-leute.

19-40. Die Rolling. H. F. Marquardt. *Iron and Steel Engineer,* v. 23, Jan. '46, p. 68-72.

Its development has transferred much of the tedious work of the forge shop to the rolling mill and resulted in increased production of complicated shapes with material savings.

19-41. Forgings and Stampings, Part II. J. R. Handforth and J. Towns Robinson. *Metal Industry,* v. 68, Jan. 11, '46, p. 28-30.

Preparation of aluminum blanks for forging.

19-42. Stamping Electrical Steels. Guy M. Shingledecker. *Tool Engineer,* v. 15, Jan. '46, p. 42-44.

Precision in both presses and dies essential to securing long die life and accuracy in producing motor and transformer laminations. Methods and dies developed by Allegheny Ludlum Steel Corp.

19-43. Straightening Bent Propeller Shafts. *Steel,* v. 118, Jan. 21, '46, p. 108.

Special fixtures and 1000-ton hydraulic press used by Navy technicians for cold straightening of propeller shaft coupling flanges afford quick means of repairing damaged warships.

19-44. Forging and Pressforming. T. C. Du Mond. *Materials and Methods,* v. 23, Jan. '46, p. 115-119.

Hydraulic and mechanical stamping and forging presses are now made in capacities that equal all but the largest steam hammers. Heating has improved so that less metal is lost through scale. Forging and stamping is done to unheard of tolerances. Control of presses and hammers is more precise.

19-45. Rolling, Wire Drawing, Extruding. Harold A. Knight. *Materials and Methods,* v. 23, Jan. '46, p. 120-122.

Speed of processes and accuracy of the finished products. Cold strip mill is said to roll difficult metals to accuracies varying from 0.0001 to 0.0003 in., and wire is being drawn to a diameter of 0.0001 in. Extrusion of high melting point metals and alloys, particularly nickel and copper. Zinc now being extruded commercially.

19-46. Finishing Steel Tube I.D. *Machine Tool Blue Book,* v. 42, Feb. '46, p. 230, 232.

Automatic finish sizing and surface conditioning of the i.d. of steel tube shock absorber housings is being done by one manufacturer at rate of 720 tubes an hour on a single machine. Operation consists of pushing hardened steel balls through the tubes to finish them to 1 in. i.d. Employs hydraulic press equipped with automatic indexing fixture. An automatic loading and feed mechanism for the balls also built into machine. Details given.

19-47. Short-Run, Low-Cost Dies. *Western Machinery and Steel World,* v. 37, Jan. '46, p. 16-18.

Rubber, plastics, plywood, Masonite, cast zinc alloy (Kirksite) and other similar materials used in these tools. Many were produced on wood-working machinery, and requirements for highly skilled toolmakers were reduced to a minimum.

19-48. Production Press Work. Gordon B. Ashmead. *Western Machinery and Steel World,* v. 37 Jan. '46, p. 20-23.

Punch presses for production of outer and inner cases and washers range in capacity from 20-ton to 150-ton units. They are interconnected by ingenious conveyors, so that there is no handling problem beyond the feeding of the press itself. Efficient production control methods insure delivery to the assembly line at the proper time to coordinate with production of the flanges and springs.

19-49. Forging Die Design. John Mueller. *Steel Processing,* v. 32 Jan. '46, p. 39-42.

General article describing various methods and results of rolling, forging, and hammering.

19-50. Processing and Fabrication of Stainless Steel Sheet and Plate Products, Part IV—Cold Working of Chromium-Nickel Materials. H. S. Schaufus. *Steel Processing,* v. 32, Jan. '46, p. 43-46, 59.

Effects of cold working on the principal properties of the material.

19-51. Cold Rolled Carbon Steel Strip—I and II. *American Machinist,* v. 90, Jan. 31, '46, p. 121, 123.

Tables give crown tolerances; standard size specifications; width tolerances; thickness tolerances.

19-52. An Upsetter "That Almost Thinks" at Ford Motor Co. P. D. Aird. *Modern Industrial Press,* v. 8, Jan. '46, p. 13-14, 16, 24.

Turns out automobile axle shafts with a 3½-in. diameter flange upset in four forging operations, at the rate of more than 600 per hr.

19-53. Design Rolling or Rigidizing Light Metals. Richard S. Smith. *Modern Metals,* v. 2, Feb. '46, p. 8-11.

Early development work, the process, fabrication, and some of the uses.

19-54. Fabricating Aluminum Into Difficult Shapes. *Modern Metals,* v. 2, Feb. '46, p. 27, 29.

Manufacture of a deep drawn aluminum bomb tube and an aluminum communications tube. Drawn aluminum-

clad steel beer cans have several advantages over other types of cans. Some of the press developments.

19-55. **Forgings and Stampings. Their Manufacture and Production in Aluminium Alloy. Part III.** J. R. Handforth and J. Towns Robinson. *Metal Industry,* v. 68, Jan. 18, '46, p. 43-45.

Plant required for making forgings.

19-56. **Rolling Magnetic Tape.** *Bell Laboratories Record,* v. 24, Jan. '46, p. 21-23.

Illustrated description of preparation of magnetic tape from ingot to finished product.

19-57. **Flame Spinning—a New Fabrication Process.** *Oxy-Acetylene Tips,* v. 15, Jan. '46, p. 21-22.

How the process works; mechanical equipment; flame spinning converter tubes.

19-58. **Theory of Forging Hammers and Their Foundations.** W. C. Andrews. *British Steelmaker,* v. 12, Jan. '46, p. 38-40.

Mass of hammer in contact with the ground need not be large. A shallow base of large area is desirable. A method of lowering the effect of the blow to the ground by the use of springs or some similar method is necessary. Attention should be given to the natural frequency of the various parts of the structure. Frequency of springing should be adjustable. Design of pistons should be reconsidered with a view to increasing the piston size. (Abstract of paper for Institution of Engineers and Shipbuilders.)

19-59. **Forgings and Stampings. Their Manufacture and Production in Aluminium Alloy. Part IV.** J. R. Handforth and J. Towns Robinson. *Metal Industry,* v. 68, Jan. 25, '46, p. 66-68.

Manufacture of forgings.

19-60. **Design and Production Technique, Part IV: Principles Involved in Drawing.** A. J. Schroeder. *Aircraft Engineering,* v. 17, Dec. '45, p. 363-369.

How a drawing operation can be saved by suitable selection of the intermediate diameters for stepped components of the same depth and the same initial diameter. Application of the diagrams ascertaining the number of drawing operations for stepped components is permissible, but with the restriction that the various intermediate diameters of the individual drawing operations are kept close to values given, because otherwise wrong numbers of drawing operations will result.

19-61. **Wax Drawing Compound.** E. A. Bunting. *Steel,* v. 118, Feb. 11, '46, p. 88-89, 138.

For press-forming metals; adaptable to alloy steels and brass, prevents atmospheric corrosion, and is reported to increase die life and reduce die maintenance. Compound dries to form a coating clean to handle.

19-62. **Rolling of Metals; Theory and Experiment. Part VII.** L. R. Underwood. *Sheet Metal Industries,* v. 23, Jan. '46, p. 67-76.

Factors influencing rolling load and specific roll pressure with special reference to thin sheet and strip rolling. 13 ref.

19-63. **Practical Problems of Light Presswork Production.** *Sheet Metal Industries,* v. 23, Jan. '46, p. 89-94, 96.

Producing complex shapes; tool development; tool trials; try-out procedure; materials and their importance in successful running; difficulties with steel and brass; copper; the importance of using the correct grade.

19-64. **Light Metal Stamping.** Roy Fellom, Jr. *Light Metal Age,* v. 4, Jan. '46, p. 8-9.

Scope and possibilities of stamping light metals; latest methods; some examples of stamping procedure.

19-65. **Forging With Closed Dies in Hydraulic Presses.** C. W. Hinman. *Machinery,* v. 52, Feb. '46, p. 176-178.

Aluminum, magnesium, brass, and other non-ferrous alloys can be forged into deep, intricate patterns in closed dies. Dies for hydraulic press forgings, having less draft, are simpler and cheaper to finish.

19-66. **Improved Die Pad Speeds Production.** *Production Engineering and Management,* v. 17, Feb. '46, p. 78.

Pad is a solid chunk of synthetic rubber weighing 2800 lb. and measuring 116 in. long, 50 in. wide and 8 in. thick; it is used as the female die in hydraulic presses to form heated magnesium under 5000 tons pressure. When compressed, the rubber transmits the full pressure of the hydraulic ram against the sheet, flowing into all irregularities and forcing the metal into the desired shape. When the pressure is released the rubber returns to its original form.

19-67. **The Manufacture of Seamless Steel Tubes.** J. W. Jenkin. *Metallurgia,* v. 33, Jan. '46, p. 139-144.

Cold work; cold drawing; pickling; lubrication; straightening; annealing; heavy reduction; purpose of cold work.

19-68. **Cold Rolling.** C. E. Davies. *Metallurgia,* v. 33, Jan. '46, p. 147-153.

Recent progress in the design of rolling mills and in the cold rolling practice of steel strip and sheets in Great Britain. (Abridged translation of paper presented at meeting of the "Chambre Syndicate des Lamineurs a Froid" held in Paris early last year.)

19-69. **Tables of Rolling Pressures and Power Requirements for Rolling Steel Shapes.** *Blast Furnace and Steel Plant,* v. 34, Feb. '46, p. 250.

Translated and compiled by F. Waldorf from the German text published by J. Puppe in 1913, under the auspices of Vereins Deutcher Eisenhüttenleute.

19-70. **Circular Bulging of Aluminum-Alloy Sheet at Room and Elevated Temperatures.** George Sachs, George Espey and G. B. Kasik. *Transactions of the American Society of Mechanical Engineers,* v. 68, Feb. '46, p. 161-173.

Preliminary results are reported on the strength characteristics and forming limits of various aluminum alloy sheets, when subjected to hydraulic pressure over a cir-

cular area at temperatures up to 500° F. Strain distributions were analyzed by means of a photogrid, after these bulges failed. 3 ref.

19-71. **How to Work Stainless Steel.** Harold L. Flynn. *American Machinist,* v. 90, Feb. 28, '46, p. 105-124.

Best current methods for fabrication; machining; heat treatment; forging; scale removal; welding; riveting; soldering; cold working; finishing.

19-72. **Deep Drawing Filter Cases. Part III.** Carl J. Nagel. *Tool and Die Journal,* v. 11, Feb. '46, p. 80-82.

Blanking; three deep drawing, forming, trimming and punching operations that make the case for the Type F-40 Fram filter.

19-73. **Forgings and Production Opportunities.** Victor Brown. *Screw Machine Engineering,* v. 7, Feb. '46, p. 66-69.

Some recent notable accomplishments of the forging industry; salient characteristics of forgings; properties of forgings; examples of special qualities in forgings and cases of cost reductions.

19-74. **Extrusion of Aluminum Alloys.** T. L. Fritzlen. *Metal Industry,* v. 68, Feb. 8, '46, p. 103-106.

Characteristics of the extrusion press and auxiliary equipment are limiting factors in production. Ingot size and structure affect the rate of extrusion—longer ingots and higher extrusion ratios require greater pressure. The stronger alloys require lower pressure in the homogenized condition than in the as-cast state. 11 ref.

19-75. **Forgings and Stampings. Their Manufacture and Production in Aluminum Alloy. Part VI.** J. R. Handforth and J. Towns Robinson. *Metal Industry,* v. 68, Feb. 8, '46, p. 111-114.

Inspection and testing of forgings.

19-76. **The Rolling of Metal: Theory and Experiment. Part VIII.** L. R. Underwood. *Sheet Metal Industries,* v. 23, Feb. '46, p. 269-281, 288.

Theories of rolling applicable to thin sheet and strip.

19-77. **Practical Problems of Light Presswork Production.** J. A. Grainger. *Sheet Metal Industries,* v. 23, Feb. '46, p. 293-298.

Shallow drawn work; relative factors governing the use of single or double action presses and further data on power rating consideration.

19-78. **Developments in Rubber Press Die Work.** F. L. Joyce. *Machinery (London),* v. 68, Feb. 7, '46, p. 181-186.

Free-rubber practice; free-rubber and trapped-rubber applications compared; effect on tool design; trapped soft rubber; economy of operation; characteristics of various media; a practical application.

19-79. **Developments in Production Forging.** E. Simister. *Metallurgia,* v. 33, Feb. '46, p. 173-177.

Forging hammers; drop forging; counterblow hammer; press forging; machine forging; quality control; auxiliary equipment.

19-80. **Developments in the Manipulation of Aluminum Alloys.** R. Worsdale. *Metallurgia,* v. 33, Feb. '46, p. 193-196.

By improved techniques production problems that previously defied solution have been overcome. Manipulation of tubing, extruded bars and sections.

19-81. **Fabricating Aluminum Sheet.** R. P. Kytle, Jr. *Steel,* v. 118, March 11, '46, p. 92-93, 130, 132, 134, 137.

Flat sheet method of fabricating aluminum from ingots weighing several hundred pounds yields to faster, more efficient coil process—hot rolling into coils and finish rolling to gage in coil form. Other significant changes in procedure summarized.

19-82. **Deep-Drawing of Magnesium.** Ralph G. Gillespie. *Machinery,* v. 52, March '46, p. 145-155.

There is practically no limit to the gage of magnesium that can be drawn. Advances in the process are considered remarkable. Application to drawing radar housing, cooking grills, generator housing, oxygen bottles; other containers.

19-83. **Forming Heavy Plate With Kirksite Dies.** L. R. Pistoles. *Iron Age,* v. 157, March 14, '46, p. 74-75.

Alloy can be cast to within $\frac{1}{64}$ in. per ft. of the desired shape and size; has a compressive strength of 60,000 psi., and a tensile of 36,000 psi.; forming done on a hydraulic press using 800 tons pressure, or about 3000 psi. when spread over the entire plate area. To overcome softness, recess cast at edges of the die, and soft tool steel inserts added all around, holding these in place wtih capscrews.

19-84. **Hydropress Blanks Boiler Plate.** Walter J. Kamp. *American Machinist,* v. 90, March 14, '46, p. 99-101.

3500-ton press with 1000-ton pressure cushion provides flat and accurate parts from steel stock up to ⅞ in. thick.

19-85. **Direct Extrusion of Magnesium.** John Alico. *Light Metal Age,* v. 4, Feb. '46, p. 18-22.

Metallurgical advantages and mechanical properties; extrusion process; extrusion of tubing of hollow shapes; ratio of reduction; quenching; relation of speed, temperature and pressure; advantages of the extrusion process; applications for magnesium extrusions. 5 ref.

19-86. **The Spinning of Zinc Ribbon From Ingot Zinc, for Use in Extractor Boxes in the Reduction Works at Government Gold Mining Areas, Limited.** J. C. Phillips. *Journal of the Chemical, Metallurgical and Mining Society of South Africa,* v. 44, Sept.-Oct. '45, p. 119-124.

Method for producing zinc ribbon 0.078 in. wide, 0.002 to 0.004 in. thick and 50 to 60 ft. long by pouring high purity zinc onto a 10-in. diameter, water-cooled steel pipe revolving at 630 r.p.m.

19-87. **Development of Forgings and Stampings.** J. Towns Robinson. *Steel,* v. 118, March 18, '46, p. 110-111, 141, 143.

British metallurgists and engineers search for cast and wrought aluminum alloys with greatly improved properties. High-strength materials ideally suited to specialized mass production heat treating and forging, or stamping methods. Forging problems, properties of stampings.

19-88. **Controlled-Stage Process Finish-Forges Turbojet Blades.** C. E. Wilderman. *Aviation,* v. 45, March '46, p. 81-83.

Method which produces high alloy aircraft turbine blades having a superior degree of accuracy as well as essential smoothness of finish.

19-89. **The Rolling of Metal: Theory and Experiment. Part VIII.** L. R. Underwood. *Sheet Metal Industries,* v. 23, March '46, p. 475-489, 494.

Theories of rolling applicable to thin sheet and strip. 33 ref.

19-90. **Practical Problems of Light Presswork Production.** J. A. Grainger. *Sheet Metal Industries,* v. 23, March '46, p. 497-504.

Shallow drawing as a breaking down operation; drawing various shapes; ears; puckering; uneven shapes; stretching under the press; a disadvantage of stretch-forming; lubrication of the blank; material and its influence.

19-91. **Deep Drawing Filter Cases, Part III.** *Tool and Die Journal,* v. 11, March '46, p. 84-86.

Tooling and blanking, drawing and finishing operations required to produce the Type F-40 Fram filter.

19-92. **Antifriction Die Sets and Die Aligners.** *Iron Age,* v. 157, March 21, '46, p. 53.

Entirely new style of die set in which precision antifriction bearings have been built into guides; are available with either square or round pins; in the former, roller bearings are employed, while in the latter, ball bearings are used. Special wear resisting alloy steel is usd for the pins, and these are hardened and precision ground.

19-93. **Deep Drawing of Steel Tubs.** *Steel Processing,* v. 32, March '46, p. 161-163.

Average depth of completed tubs is 16 in. Some are as shallow as 13¼ in. and some as deep as 22 in. Diameters are not constant but vary between 21⅞ in. and 23 in. Raw material is circular blanks of 18 and 19-gage enameling steel, averaging 44 in. in diameter; operation described.

19-94. **Jet Airplane Engine Parts Produced on High Speed Presses.** *Steel Processing,* v. 32, March '46, p. 178-180.

Two H-P-M Fastraverse presses are employed to draw and form the many component parts. Some engine parts are made from aluminum alloy, others from stainless steel, depending upon whether parts are subjected to high temperatures.

19-95. **The Case for Drop Forging.** R. E. W. Harrison. *American Machinist,* v. 90, March 28, '46, p. 135-136.

Factors to be considered in a forging decision. Better material, not more weight, may be the answer to a doubtful part in a machine. Chart may be used to determine relative merits of impact and squeeze methods.

19-96. **Production Principles for Deep Drawn Magnesium Parts.** Ralph G. Gillespie. *Materials and Methods,* v. 23, March '46, p. 701-705.

Magnesium alloy becomes readily workable when prop-

erly heated and dies are designed to meet magnesium's requirements.

19-97. **Diamond Dies for Wiredrawing.** C. K. Wall. *Materials and Methods,* v. 23, March '46, p. 717-719.

Diamond dies turned out in large quantities by high-speed precision methods.

19-98. **Machine Built With Manifold Dies Points Steel Tubes.** *Steel,* v. 118, April 1, '46, p. 141, 209.

Hydraulically operated dies shape end of ferrous tubes suitable for gripper jaws of drawbench. Production at some plants increased 100% with 50% less labor. Die stroke is synchronized. Pickling is facilitated.

19-99. **Tables of Rolling Pressures and Power Requirements for Rolling Steel Shapes.** *Blast Furnace and Steel Plant,* v. 34, March '46, p. 370.

Translated and compiled by F. Waldorf from the German text published by J. Puppe in 1913, under the auspices of Vereins deutcher Eisenhüttenleute.

19-100. **Progress in Drawing Tubing and Sheet Metal on Carbide Dies.** Earle Glenn. *Modern Industrial Press,* v. 8, March '46, p. 32, 42.

Carbide dies and mandrels increase the linear feet produced on the drawbenches from 20 to 25% over the speed obtainable with steel dies and mandrels. In addition, carbide dies have: *(a)* permitted holding the finished tubing to closer tolerances over a longer period of time; *(b)* given a superior finish; and *(c)* shown a service life ratio of from 20 to 30 to 1 (at a conservative estimate) over steel for similar operations.

19-101. **Some Observations on Seamless Tube Making.** Newell Hamilton. *Iron and Steel Engineer,* v. 23, March '46, p. 55-61.

Various designs of piercing mills and some of the factors essential to the production of sound steel for the process.

19-102. **Roll Manufacture.** A. E. Murton. *Iron and Steel,* v. 19, March '46, p. 97-101.

Types of rolls in common use in American rolling mill practice; brief discussion of the methods of their manufacture and of conditions which influence their applications.

19-103. **Precision "Atmosphere" Forging.** E. G. de Coriolis. *Steel,* v. 118, April 8, '46, p. 90-94.

Where freedom from scaling, surface irregularities, decarburization, and forming to precise dimensions are advantageous in the forging of thin-section steel parts, especially if they must be repeatedly heated and cooled, the methods developed for propeller blade parts may materially reduce the number of operations required and decrease the amount of waste material, while producing a more uniform and reliable product. Shows propeller blade before and after welding into a unit; cross-section of the four parts of the center section of the blade; one of the plates in the center section and successive steps in forging trailing edge of the blade from round bar stock.

19-104. **Improving the Formability of N.E.8630 Steel Sheet.** J. L. Waisman and W. T. Snyder. *Metal Progress,* v. 49, April '46, p. 755-760.

Elimination of cracking during forming solved by employing different thermal treatments followed by sandblasting, prior to the forming operation. Combined treatment had the dual effect of eliminating troubles at the sheared edges and increasing the ductility of the material. Effect of four different thermal treatments on the formability of normalized N.E.8630 sheet was investigated.

19-105. **Forming Magnesium.** *Modern Metals,* v. II, April '46, p. 14-18.

Forming method for magnesium alloys and factors which affect workability. Lubricants, blanking and shearing. Tables give design characteristics, corrosion ratings, heating properties and forming characteristics. (From booklet "Designing With Magnesium".)

19-106. **Fine Wiredrawing.** S. C. Avallone. *Iron Age,* v. 157, April 11, '46, p. 64-65.

Technique now used in this country for successful production of fine wire on a large scale. Potential postwar markets for this item.

19-107. **Cold Bending of Pipe and Metal Shapes.** E. J. DeWitt and Harry S. Nachman. *Machinery,* v. 52, April '46, p. 141-150.

Principles involved in the bending of pipe, tubes, and other metal shapes; types of bending machines; the application of ram and rotary automatic and manually operated machines.

19-108. **Typical Examples of Contour Forming.** Cyril J. Bath. *Machinery,* v. 52, April '46, p. 181-184.

That which can be done by stretching and that which can best be compress-formed. Gives a few guiding principles.

19-109. **High-Speed Perforating of Sheet Metal.** *Machinery,* v. 52, April '46, p. 186-187.

Sheets 40 in. wide by 60 in. long are perforated at speeds up to 360 strokes per minute.

19-110. **Aluminum Spinning.** *Automobile Engineer,* v. 36, March '46, p. 136-137.

Spinning lathes; spinning speeds; chucks; hand tools; spinning technique.

19-111. **Forging Aluminum Pistons on Mehanical Presses.** *Machinery (London),* v. 68, March 21, '46, p. 361-363.

Process involves use of a forging press of 2000 tons capacity. Aluminum alloy is received in the form of round bars 3½ in. diameter by 10 ft. in length. Material specification calls for A.M.S. 4145 or 32S aluminum alloy. After being tested for conformity to the specification, bars are cut up into lengths of 7½ in. by employing an abrasive sawing machine. Billets must each weigh 7.1453 lb. within limits of plus ¾ oz., minus zero.

19-112. **The Reasons for and the Advantages of Shaving Hot Rolled Copper Rods.** E. W. Clark. *Wire and Wire Products* v. 21, April '46, p. 308, 334-335.

Improvement in the insulating qualities of coated wire, such as conventional enameled wire and those coated with Formvar and other synthetic varnishes result from use of wire drawn from shaved rods; besides removing all slivers, shaving also removes the porous surface inherent in a rod that has been hot rolled and then pickled.

19-113. **Designing for Mechanical Press Forging.** John R. Parks. *Tool Engineer,* v. 16, April '46, p. 39-43.

New technique in hot forming metals that is applicable to any metal that can be forged by hammering, with advantage that machine is a self-contained unit with low maintenance cost and can be operated at a high production rate by a comparatively unskilled operator. Press forging of aluminum and magnesium described. Method has also been applied to ferrous alloys but difficulties in die maintenance have proved great; best success has been with shapes such as gear blanks that can be forged without excessive movement of the metal in the die cavity or out into the gutter.

19-114. **Wiredrawing Machines—Past, Present and Future.** N. Davidson. *Wire Industry,* v. 13, April '46, p. 211-214, 220.

Improvements in wiredrawing machines since 1930; continental practice; factors influencing production; saving power costs; wet drawing developments; rest between reductions; production speed; cleaning and coating control; tungsten carbide die; foreign trends; coming types; alloys; swaging and extrusions; future research and trends.

19-115. **Some Problems in High-Speed Fine Steel Wiredrawing.** S. C. Avallone. *Steel,* v. 118, April 22, '46, p. 88-90.

Thorough cleaning of all foreign matter from surfaces of wire is essential to avoid abnormal die life and to obtain peak production. Coating product at cleaning crane prevents discoloration and rust Concentration and temperature of lubricant are important.

19-116. **Plunger-Type Stops for Short-Run Press Tools.** D. D. Morgan. *Machinery (London),* v. 68, April 4, '46, p. 435-437.

Plunger-type stops are cheap, simple, yet quite efficient, and meet the need for trouble-free stock feeding in tools of low initial cost.

19-117. **Carbide Die Applications, Present and Future.** Earle Glen. *Iron Age,* v. 157, April 25, '46, p. 51-54.

Deep drawing carbide dies as large as 13½ in. i.d. are among the newer uses of carbide dies described. Many other applications are reviewed in detail in appraisal of present and future carbide die applications.

19-118. **Steel Forgings.** *Iron and Steel,* v. 19, April '46, p. 173-175.

Manufacture of armament and other components in Germany.

19-119. **Failure of Autobody Sheet in Deep Drawing Operations.** *Steel,* v. 118, April 29, '46, p. 122, 136, 138, 140-141.

Results in England of forming autobody steel blanks from various heats, differing only slightly in chemical makeup but widely in reaction to carburizing test for

grain size, led British metallurgist, K. J. B. Wolfe, to postulation here challenged by H. W. McQuaid. Control of grain size by carbide or oxide particles held of relatively remote interest.

19-120. **The Rolling of Metals—Theory and Experiment. Part IX.** L. R. Underwood. *Sheet Metal Industries,* v. 23, April '46, p. 677-684, 696.

Calculation and specific roll pressure for strip and sheet with strip tension and work hardening by means of the preceding theories. 30 ref.

19-121. **Tables of Rolling Pressures and Power Requirements for Rolling Steel Shapes.** *Blast Furnace and Steel Plant,* v. 34, April '46, p. 482 and insert between p. 482 and 483.

Translated and compiled by F. Waldorf from the German text published by J. Puppe, Düsseldorf, Germany, in 1913, under the auspices of Vereins Deutcher Eisenhütten-leute.

19-122. **Heating for Bending and Straightening.** *Oxy-Acetylene Tips,* v. 25, April '46, p. 37-42.

Intense, localized heat of oxy-acetylene flame, plus its speed, easy control, economy, and convenience make it the most efficient source of heat for numerous forging, forming, straightening, bending, and pressing operations. Feature of the process is that it applies heat exactly where it is needed and prevents overheating. Large-capacity heating blowpipes and multiflame heating heads instantly give the operator an easily controlled flame of approximately 6000° F.

19-123. **The Technique of Metal Spinning.** Edwin Weiss. *Machinery,* v. 52, May '46, p. 159-164.

Construction of forms; tools used; shapes; materials that can be spun; size limitations of the spinning process.

19-124. **Tools for Use in Bending Machines.** E. J. DeWitt and Harry S. Nachman. *Machinery,* v. 52, May '46, p. 188-191.

Forms, clamping dies, stationary pressure dies, and shoes used in connection with bending machines for pipe, tubes, and other metal shapes.

19-125. **Contour Forming—a Wartime Machine Meets a Peacetime Need.** P. D. Aird. *Modern Industrial Press,* v. 8, April '46, p. 13-14, 34.

Machine consists primarily of a revolving die working in conjunction with predetermined hydraulic pressures, thereby forming metal parts under tension or compression. Rigid construction and constant pressures provide accurate forming with duplication. Machine, though operating as a unit, consists of two parts—the circular "table" on which the forming dies are located and the hydraulic mechanism which maintains pressure on the work.

19-126. **Injection Molding of Steel.** Thomas A. Dickinson. *Modern Industrial Press,* v. 8, April '46, p. 30-32, 46.

Press is a hydraulically operated machine equipped with Ajax-Northrup high frequency (or coreless) induction heating apparatus. Molten steel is fed into the injection

tube hopper by means of a tilting furnace, in which the induction heating apparatus has been incorporated. Then it is forced from the injection tube into a closed mold by actuating a suitable ram with hydraulic pressure from an injection cylinder. Press is similar to that used for plastic except that the ram has a carbide-tipped face and the nozzle is made of a high-chromium heat resisting steel. Carburetor cases, wrenches and hypodermic needles have been made.

19-127. **Designing, Drafting, and Using Press Tools.** C. W. Hinman. *Steel Processing,* v. 32, April '46, p. 239-243, 254.

Two-step perforating and blanking dies; nomenclature; operation of the die; progressive piercing and blanking dies; closed heights of press tools and die space; finger stops.

19-128. **Extrusion of Magnesium Alloys.** James L. Erickson. *Light Metal Age,* v. 4, April '46, p. 8-11, 15, 23.

Extrusion temperatures, pressures, and rates; properties of extruded sections.

19-129. **Precision Peening Depends on Whole Shot.** John C. Straub. *American Machinist,* v. 90, May 9, '46, p. 109.

Experience shows that there is no economy and no guarantee of quality in letting broken shot circulate in the machine, even though contrary to custom.

19-130. **The Sendzimir Precision Cold Strip Mill.** T. Sendzimir. *Iron and Steel Engineer,* v. 23, April '46, p. 53-60, 66.

It has long been recognized that rolling with small diameter rolls has many advantages, particularly, if the main objection of roll deflection could be overcome. The Sendzimir mill offers one solution to this problem. Fields of application to which it is particularly adapted include: for reduction of wide strips of relatively hard metals down to light gages; for very wide strips (60 to 100 in.) of any analysis; for accurate strip (gage tolerance of from 0.0001 to 0.0003 in.); for high-production type of work; for heavy raw materials; where heavy single-pass reductions are desirable.

19-131. **Iron and Steel Engineers Hold Symposium on Rolling Practice.** *Steel,* v. 118, May 13, '46, p. 98-99, 152.

Well-rounded program of papers on rolling mill practice and equipment featured the annual spring conference of the Association of Iron and Steel Engineers.

19-132. **Contour Forming.** *Machine Tool Blue Book,* v. 42, May '46, p. 199-214.

A number of typical forming jobs illustrated and described. Contour forming offers many interesting economies and considerable opportunity for improvement in appearance, but will not generally compete with press-type operations.

19-133. **Tables of Rolling Pressures and Power Requirements for Rolling Steel Shapes.** *Blast Furnace and Steel Plant,* v. 34, May '46, p. 594 and insert.

Translated and compiled by F. Waldorf from the Ger-

man text published by J. Puppe, Dűsseldorf, Germany, in 1913, under the auspices of Vereins Deutcher Eisenhuttenleute.

19-134. **Recent Developments in Presses Increase Production Rate.** *Production Engineering & Management,* v. 17, May '46, p. 67-70.

Recent improvements have made possible increased production rates, lower costs, greater accuracy, less downtime, higher efficiency, increased flexibility, and greater protection to workers. Survey of leading manufacturers of presses reveals not only many improvements but also importance of these advances in the production of stampings.

19-135. **Combined Cutoff and Form Dies Provide Economical Operation.** Charles R. Cory. *Production Engineering & Management,* v. 17, May '46, p. 91-96.

Solid forming and cutoff dies for straight break lines, and spring-loaded pressure pad dies for more complex multiple hit work.

19-136. **Electronic Melting Furnace Facilitates Injection Molding of Steel.** S. M. Milanowski. *Steel,* v. 118, May 27, '46, p. 86-87, 128, 130.

Electromagnetic force released by high-frequency coil in melting chamber insures homogeneity of alloys. Simple, high-speed process for products weighing up to 15 lb.

19-137. **Half-Century of Forging.** *Steel,* v. 118, May 27, '46, p. 107-110.

Erie Foundry Co.'s span of over 50 years covers the development of forging hammers from the original 600-lb. single-frame machine to 50,000-lb. giants.

19-138. **Cold Forged Inserts.** William G. Waltermire. *Fasteners,* v. 3, May '46, p. 11-13.

Metal inserts have for some time been used extensively, particularly in plastics, to form a base for a thread when the parent material is not suitable. Cold forging of these inserts has many advantages.

19-139. **Deep Drawing Filter Cases. Part III.** *Tool & Die Journal,* v. 12, May '46, p. 89-92.

Details of the tooling for the third draw and subsequent forming operations.

19-140. **The Brehm Trim ("Shimmy") Die.** *Tool & Die Journal,* v. 12, May '46, p. 89-99.

Die will trim entire edge of most shells in one press stroke using a shear action similar to a blanking die. In some types of shells, notches or projections can be obtained when trimming.

19-141. **Evaluation of the Forming Properties in Bending of Five Commercial Sheet Aluminum Alloys.** G. R. Gohn and S. M. Arnold. *American Society for Testing Materials Preprint* 19, 1946, 9 p.

Two methods of test developed for evaluating the forming characteristics in bending of sheet and strip metals, one by means of a punch and die setup, the other by means of a bending brake.

19-142. **Impact Extrusions.** Herbert Chase. *Materials & Methods,* v. 23, May '46, p. 1323-1334.

Materials used; methods of production; tooling processes and costs; dimensions and tolerances; design considerations; comparisons with competitive products.

19-143. **The Extrusion of Magnesium.** James L. Erickson. *Light Metal Age,* v. 5, May '46, p. 11-16.

The extrusion of magnesium alloys is carried out in hot state employing preheated billets which are free from flux inclusions, dross, hard constituent, shrinkage, and pipe. Pressures between 40,000 and 60,000 psi. are exerted on the extrusion billet during the extrusion process while the billet is kept within a specific predetermined elevated temperature range.

19-144. **Die for Forming Tension Clip.** *Machinery (London),* v. 68, May 9, '46, p. 601-602.

Die shown performs forming operations as required, placing contacting ends under the desired tension. End and plan views of die are shown.

19-145. **New Marshall Richards Nonslip Model—Multiple-Hole High-Speed "Pacemaker" Wiredrawing Machine.** *Wire Industry,* v. 13, May '46, p. 265-267.

Machines operate at maximum possible speed, and at highest possible efficiency in any size or grade of wire. They can be supplied as two-hole to nine-hole machines, equipped with from two to nine blocks, and with integrally built driving motors of suitable horsepower. Each block is independently driven by a specially designed variable speed d.c. motor. Finishing block can be pre-set to run at the highest possible speed at which any size or grade of steel wire can most economically be drawn, having regard to the final physical properties required.

19-146. **The Rolling of Metals. Part X.** L. R. Underwood. *Sheet Metal Industries,* v. 23, May '46, p. 883-892.

Roll flattening and the circulation of specific roll pressure with flattening.

19-147. **Practical Problems of Light Presswork Production—Deep Drawing.** J. A. Grainger. *Sheet Metal Industries,* v. 23, May '46, p. 905-908, 912.

Die design; design of a draw edge; draw faces; draw edges for redrawing operations.

19-148. **Hot Extrusion of Steel Tubing.** Gurdon M. Butler. *Steel,* v. 118, June 3, '46, p. 126, 129-130.

Process employed by Mannesmann Tube Works at Annen, Germany. Amount of graphite and oil poured over billet is carefully determined to avoid an explosion during extrusion. Mandrel coated with weld metal of same analysis as die ring. Coating ground to ⅛-in. thick and then heat treated. Mandrel life ranges from 400 to 500 tubes.

19-149. **Distortion Due to Contour-Forming of Extrusions and Preformed Sheet Metal Sections.** William Schroeder. *Transactions of the American Society of Mechanical Engineers,* v. 68, May '46, p. 287-292.

Effect of springback on the radius of curvature due to

contour-forming of extrusions or preformed sheet metal sections is analyzed. A number of the commonly used methods of forming are considered. Equations for computing values for change in radius are derived and sample calculations are compared.

19-150. **Metal-Spinning—a New Flame Process.** *Welding Engineer,* v. 31, May '46, p. 58-59.

Applications include gas cylinders, shock absorbers, refrigerating-unit members and other shaped tubular parts.

19-151. **New Hot Strip Mill.** *Canadian Metals & Metallurgical Industries,* v. 9, May '46, p. 20-22.

To meet the increasing demands in Canada for flat rolled steel products and to keep in tune with the times from the standpoint of quality, quantity, and economy of operations, The Steel Co. of Canada, Limited, of Hamilton planned, just prior to the outbreak of war, to enlarge substantially its activities in this field.

19-152. **Extrusion—a Comparison of Direct and Indirect Methods.** A. Ahearne Heron. *Metal Industry,* v. 68, May 17, '46, p. 389-390.

Suggests a solution to two distinct problems: difficulties of slow speed and inconsistency of product encountered in the extrusion of certain nonferrous, particularly aluminum, alloys, and, secondly, the production of bar without pronounced flow characteristics.

19-153. **Heat Exchanger.** G. Eldridge Stedman. *Steel,* v. 118, June 10, '46, p. 88-90, 134.

Central assembly for gas refrigerator heat assembly has 34 exchanger cups made on seven-station progressive die with automatic carrier track and fingers for moving work from station at each stroke.

19-154. **Stamping Clutch Lever Parts.** Leroy Barrett. *Steel,* v. 118, June 10, '46, p. 96, 145.

Production method cuts costs; performance of parts in their end use improved.

19-155. **Pierced Metal Parts.** *Western Machinery and Steel World,* v. 37, May '46, p. 245-247.

Illustrates and describes examples that call attention to the possibilities of complex piercing techniques.

19-156. **The Forging of Magnesium.** Arnold L. Rustay. *Machinery,* v. 52, June '46, p. 141-148.

By the combination method—first blocking the stock in a hydraulic press and then finishing under a hammer—forgings have been successfully produced from cast "multiples" or blanks of various magnesium alloys. Large number of forgings involving light and heavy sections and many different types of metal flow produced by the combination method.

19-157. **Properties and Limitations for Stepped and Tapered Extrusions.** W. H. Arata. *Product Engineering,* v. 17, June '46, p. 487-491.

Two new types of extrusions—limitations; advantages; applications; tolerances and design data. Use of rolled billets is recommended for parts of sizes larger than those that can be made by the extruding process.

19-158. **Tandem Die Sets Reduce Tool Costs.** R. Regan. *Production Engineering & Management,* v. 17, June '46, p. 71-72.

Standard mountings provide extreme flexibility and assure appreciable setup savings for short runs.

19-159. **Perforating Press.** *Steel,* v. 118, June 17, '46, p. 109, 156.

Offers unusual accuracy in feeding mechanism. Precision dies aid fine operations.

19-160. **18,000-Ton Forging Press.** L. E. Browne. *Steel,* v. 118, June 17, '46, p. 114-116, 156.

Huge Mesta forging press, together with special forging and heat treating furnaces, produces large magnesium and aluminum alloy forgings; new $5,000,000 Wyman-Gordon plant is especially designed to house the 2050-ton unit and auxiliary equipment.

19-161. **Nonferrous Forgings.** Carl H. Pihl. *Steel,* v. 118, June 17, '46, p. 130-132, 134.

Copper and aluminum alloys available for die-pressed or hammered forgings exhibit full range of mechanical properties. Using slugs from ingots or rods, method economically produces irregularly shaped parts.

19-162. **The Hydraulic Circuit in Bending Machines.** E. J. DeWitt and Harry S. Nachman. *Machinery,* v. 52, June '46, p. 149-151.

Principal considerations in the design and application of hydraulic circuits used in machines for bending pipe, tubes, and other metal shapes.

19-163. **Features of a Well-Planned Shop.** *Sheet Metal Worker,* v. 37, May '46, p. 41-43, 72-73.

Lean-tos for sheet and machine storage; bamboo welding shades; machines mounted on platforms made portable with casters or stationary with bolts; retractable electric drop cords.

19-164. **The Rolling of Metals, Theory and Experiment. Part X—Roll Flattening and the Calculation of Specific Roll Pressure With Flattening. Part XI—Spread During Rolling.** *Sheet Metal Industries,* v. 23, June '46, p. 1097-1108.

Data given for no work hardening but roll flattening and strip tension, and for work hardening, front and back tension, and roll flattening. General nature of spread in rolling.

19-165. **Practical Problems of Light Presswork Production—Deep Drawing.** J. A. Grainger. *Sheet Metal Industries,* v. 23, June '46, p. 1109-1116.

Advantages of angular draw edges for redrawing; air holes in punch and die; die clearances and their calculation; blank diameters; square and rectangular forms; drawing speed.

19-166. **Deep Drawing—Some Difficulties and Developments in Practice.** J. D. Jevons. *Metal Industry,* v. 68, June 7, '46, p. 445-448.

Season cracking; critical strain crystal growth; interstage annealing; bright annealing; spray pickling; high-

frequency heating; new alloys; joining of pressings. (Extracts from paper for Institution of Production Engineers.)

19-167. **Forging Die Design—Coining.** John Mueller. *Steel Processing,* v. 32, June '46, p. 376-378.

Where quantities are of sufficient size to warrant the expenditure for coining equipment, duplicate parts may be sized to a smooth finish, at a low cost, to specified dimensions within a few thousandths of an inch.

19-168. **How to Select and Work Aluminum.** C. F. Palmer. *Sheet Metal Worker,* v. 37, June '46, p. 42-44.

Forming aluminum; types of sheets available; methods of joining; methods of finishing; corrosion and thermal expansion; aluminum sheet metal applications.

19-169. **Mass Production Upset Forming of Screws and Bolts.** Fred Burt. *Modern Industrial Press,* v. 8, June '46, p. 20, 22, 24.

Production methods used by Cooper Screw Mfg. Co., Los Angeles, for manufacture of bolts, screws, rivets, studs, nuts, washers. Specific data on production of cap screw given as an example.

19-170. **Fabrication of Refrigerator Panels at Crosley Corp.** Gerald E. Stedman. *Modern Industrial Press,* v. 8, June '46, p. 26-28.

Fabrication of the cabinet outer panel has some unusual forming methods, particularly a large forming machine specially designed by the Crosley engineering department.

19-171. **Basic Dies for Deep Drawing.** Chester A. Gray. *American Machinist,* v. 90, July 4, '46, p. 90-92.

The basic dies for deep drawing are the single-action, double-action and push-through dies; a few jobs require triple-action dies. Examples of these dies, presses for their use and the common toolsteels.

19-172. **Rolling Z-Shape Sections Into Circles of Large Diameter.** *Machinery (London),* v. 68, June 6, '46, p. 721-722.

Strip 24S-T aluminum alloy is first rolled into a Z-shape in the Yoder machine illustrated, then formed into a circle of 76.74 in. inside diameter. Strip stock 3½ in. wide is fed into the machine and is trimmed to required width by first set of horizontal rolls. The thickness of the stock is 0.051 in. Seven sets of rolls on the machine proper then perform most of the rolling to the required cross section; the last set ot rolls also starts bending the shape into the large circle.

19-173. **Steel Tubing.** *Iron and Steel,* v. 19, June '46, p. 405-407.

Manufacture by hot extrusion in Germany.

19-174. **Deep Drawing and "Bulging" Stainless Steel.** J. E. Obernesser. *Steel,* v. 119, July 1, '46, p. 96-99, 114, 116.

Highly developed deep drawing and bulging technique used to fabricate dairy equipment where unusual requirements of surface finish must be met. Scrap is reduced from 10 to less than 1%.

19-175. **Designing Work for Bending.** E. J. DeWitt and Harry S. Nachman. *Machinery,* v. 52, July '46, p. 154-156.
Points to be considered in order to perform economical bending on automatic and manually operated bending machines.

19-176. **Production of Clad Steels by Rolling.** Charles H. Wick. *Machinery,* v. 52, July '46, p. 158-163.
Methods employed by Lukens Steel Co. in the manufacture of corrosion resistant clad steels; points to be observed in fabricating these steels.

19-177. **Silicone Enamel for Photo Templets.** Gilbert C. Close. *Industrial Finishing,* v. 12, July '46, p. 35-36.
Use of silicone enamel for photo templet work on magnesium sheet to be hot formed.

19-178. **Magnesium Forgings.** *Metal Industry,* v. 69, July 5, '46, p. 8-11.
An investigation into their production and properties. (Summary of two progress reports to U. S. War Production Board.)

19-179. **Processing Wire in Molten Glass.** *Ceramic Industry,* v. 47, July '46, p. 61-62.
Drawing of stainless steel using glass coating instead of lead.

19-180. **Reactive Wire Drawing. Part III.** Janet M. Howden and R. Winstanley Lunt. *Wire Industry,* v. 13, June '46, p. 329-330.
Gain in die life which may be achieved by adopting reactive drawing conditions.

19-181. **Steel Injection Molding for Small Parts Production.** John S. Hisgen. *Production Engineering & Management,* v. 18, July '46, p. 87-90.
New process and new machine for injection molding makes possible high production of small and intricate steel products without machining. Electronic heating is used to maintain metals at semimolten temperatures.

19-182. **Production Processes—Their Influence on Design. Part XIII. Cold Heading.** Roger W. Bolz. *Machine Design,* v. 18, July '46, p. 119-124.
Advantages of cold heading; description of process; design for cold heating; dies; materials suitable; tolerances.

19-183. **Automatic Press Action.** John E. Hyler. *Machine Tool Blue Book,* v. 42, July '46, p. 189-190, 192, 198, 200.
Automatic feeds are adaptable for use on any ordinary punch press without altering the press itself in any way, and will speed press production. Various types described.

19-184. **One Billion Hits Predicted for Carbide Dies.** Glen A. Barth. *American Machinist,* v. 90, July 18, '46, p. 142-143.
Two million razor blades punched by carbide dies with no signs of wear and only 0.0002-in. burr.

19-185. **Drawing, Stretching, Stamping of Aluminum.** Harry L. Smith. *Steel,* v. 119, July 22, '46, p. 88-90, 92, 94, 130.
Description of forming procedures which utilize to best

advantage special properties of Alcoa's "common alloys" and the widely used alclad series.

19-186. **Cold Forming of Truck Spindle Bolts at Ford Motor Company.** P. D. Aird. *Modern Industrial Press,* v. 8, July '46, p. 13-14, 16

Huge machine turns out 15,000 units for each 8-hr. day. Procedures outlined.

19-187. **Shot-Peening.** *Western Machinery and Steel World,* v. 37, July '46, p. 100-102.

Chart shows increase in fatigue life due to shot-peening on certain parts. 18 ref.

19-188. **Magnesium Forgings.** *Metal Industry,* v. 69, July 12, '46, p. 30-32.

Production and testing of a large structural member, namely, the swing boom cargo hoist forging for the Douglas C54B aircraft. Effect of variations in the handling of the high-strength, 8.5% aluminum, 0.5% zinc alloy on forgeability and properties. (Abstracts of progress reports for U. S. War Production Board.)

19-189. **Extruded Shapes Speed Brass Forging Output.** Herbert Chase. *Materials & Methods,* v. 24, July '46, p. 103-108.

Slugs so shaped that metal has only short distance to flow facilitate production of a variety of brass parts with one stroke of forging presses.

19-190. **Carbide Drawing Dies.** Daniel Mapes. *Steel,* v. 119, July 29, '46, p. 84, 86.

Increased output, improved product and less scrap are obtained with Carboloy dies for deep drawing steel and aluminum alloy sheets in production of high-pressure cylinders. Productive life of one average die used on 22-in. draw is 400,000 pieces.

19-191. **The Rolling of Metals: Theory and Experiment—Part XI. Spread During Rolling.** L. R. Underwood. *Sheet Metal Industries,* v. 23, July '46, p. 1291-1306.

Experimental investigation of spread in rolling; effect of breadth-height ratio, percentage reduction, and thickness ratio on spread; influence of roll diameter; effect of the coefficient of friction or roll roughness; effect of rolling speed; effect of steel composition; influence of the roll material on spread in cold rolling; influence of rolling temperature; effect of work hardening; effect of clad metal; effect of strip tension.

19-192. **Practical Problems of Light Presswork Production. Deep Prawing. (Continued.)** J. A. Grainger. *Sheet Metal Industries,* v. 23, July '46, p. 1313-1319.

Drawing speed with a brass cup; size of press required for drawing; drawing on single and double-action presses; comparison of pressure effects.

19-193. **Manufacture of 155-mm. Steel Forgings.** W. J. Jones. *Iron and Steel Engineer,* v. 23, July '46, p. 92-100.

The process adopted by the Tennessee Coal, Iron and Railroad Co. is known as the pierce and draw method. In this method, heated forging blanks, or slugs, are pierced

in a die and are then drawn to size and length in draw presses.

19-194. **The Forging Process From a Hydrodynamic Point of View.** Victor Tatarinov. *Steel Processing,* v. 32, July '46, p. 446-447, 549.

Direction and speed of flow in the ingot are affected by factors given. In accordance with these it is possible to establish equations enabling one to compute power necessary to overcome resistance of material to forging. Using the fundamental equation by hydrodynamics, properly corrected, the maximum pressure of the tool necessary to overcome the resistance of material is formulated.

19-195. **Costs Reduced by Proper Stamping Technique.** *Steel Processing,* v. 32, July '46, p. 453-454, 460.

Examples and illustrations of "small" stamping indicate wide range in application of stamping techniques and the opportunities for design engineers to use mass-production cost saving methods.

19-196. **Forging High-Alloy Rounds With V-Type Dies.** Elmer Ghrist. *Iron Age,* v. 158, Aug. 1, '46, p. 44-49.

New method of forging large-diameter, high-alloy tool-steel rounds is said to eliminate center rupture and assure uniform cross-sectional carbide distribution. Method, which employs V-type dies, permits successful forging of high-alloy rounds up to 12 in. diameter.

19-197. **Forging Practice in Wartime Germany.** C. W. Heppenstall. *Iron Age,* v. 158, Aug. 1, '46, p. 55-57.

Contrasting sharply with the ingenuity displayed in most German manufacturing processes, forging techniques appear to have lagged as much as 25 yr. behind those of the United States. Several leading German forge plants were investigated but in only one or two isolated cases were any practices found which were superior to American practice.

19-198. **Steel Can Be Guerinned Too.** *American Machinist,* v. 90, Aug. 1, '46, p. 102-103.

Sheet steel formed on hydropresses equipped with rubber pads.

19-199. **Cold Forming Oldsmobile Three-Piece Bumpers.** Charles O. Herb. *Machinery,* v. 52, Aug. '46, p. 141-149.

Unique press operations which produce three-piece bumpers from low-alloy high-tensile steel.

19-200. **Production Processes—Their Influence on Design. Part XIV—Section Contour Bending.** Roger W. Bolz. *Machine Design,* v. 18, Aug. '46, p. 129-134.

Re-forming of metal sections of all types—roll-formed sections, shapes, extrusions, etc.—normally received in straight lengths, into various contours. Wide variety of machines available including draw machines, roll machines, ram, compression, stretch, and compression-stretch machines.

19-201. **Carbide Die Use Increasing Rapidly.** Earle Glen. *Machine Tool Blue Book,* v. 42, Aug. '46, p. 187-190, 192.

Use in deep drawing, punching and blanking, tube drawing, and cold forging.

19-202. **Processing With Magnesium.** N. H. Simpson. *Metal Industry,* v. 69, July 26, '46, p. 67-68.

Blanking and shearing; forming; welding; spot welding; assembly.

19-203. **Developments in the Stamping Industry.** *Western Machinery and Steel World,* v. 37, Aug. '46, p. 113-115.

Improvements in press design include reduction of deflection, higher speeds, greater precision and faster acting controls. They enable faster tool setting, insure longer life of clutch, brakes, pumps, etc., and make use of built-up type frames. Greater effective bed area and easier repairs also result.

19-204. **Upsetting Tubular Members Simplified by Special Grippers.** Lambert R. Pistoles. *Iron Age,* v. 158, Aug. 15, '46, p. 42-48.

Method permits simultaneous upsetting of the i.d. and the cuff ring with one stroke displacing up to 45 cu.in. of metal. Special cooler designed to prevent the spread of heat from the upsetting to the gripping area.

19-205. **Heating for Bending and Straightening.** *American Machinist,* v. 90, Aug. 15, '46, p. 141.

Sketches show how and where to use oxy-acetylene flame to get best results.

19-206. **Glycerine: Friend of the Wire Worker.** Georgia Leffingwell and Milton A. Lesser. *Wire and Wire Products,* v. 21, Aug. '46, p. 604-605, 635.

Many uses of glycerine and synthetic alkyd resins made with glycerine in wire drawing and wire fabrication.

19-207. **Design of Parts to Be Formed by Metal Spinning.** C. J. Holinger. *Product Engineering,* v. 17, Aug. '46, p. 150-153.

General types of parts suited to the spinning process; properties governing the selection of materials and design tolerances; chuck design. Metal spinning process, its economy and rates of production are compared with those of deep drawing on power presses.

19-208. **Progressive Die Designed to Pierce, Notch, Cut Off and Form.** *Tool & Die Journal,* v. 12, Aug. '46, p. 80-83.

Progressive die which, in three operations, successively pierced, notched, cut off and formed an ordnance part, involves both design and construction features of postwar interest and application. Shows plan of the part after completion of the piercing and notching of the first two operations and workpiece after the third, or cut-off and form, stroke of the press. Over-all construction and assembly of the tooling is shown.

19-209. **Drawability of Aluminum Alloys.** D. M. Finch, S. Wilson and J. E. Dorn. *Metal Industry,* v. 69, Aug. 2, '46, p. 93-95.

Effects of punch radius, die radius, clearance, hold-down load, die temperature and lubrication on drawability.

19-210. **The Steel Company of Canada, Ltd., Follows Modern Practice in Production of Slabs and Blooms. Part 1.** Charles Longenecker. *Blast Furnace and Steel Plant,* v. 34, Aug. '46, p. 973-978.

Description of the operations at the Hamilton plant. Rolling of steel from the ingot for the production of strip; production of the slab from which the strip is rolled.

19-211. **Low Cost Patterns for Multistage Dies.** R. Raymond Kay. *Iron Age*, v. 158, Aug. 22, '46, p. 56-58.

Technique of building patterns for dies for the short run production of irregularly shaped parts by means of the patented Sol-A-Die process. Patterns are constructed of beeswax and cheesecloth, on the final pattern, and being flexible, may be bent to the desired form of the intermediate stages.

19-212. **Extrusions by Impact.** Herbert Chase. *Scientific American*. v. 175, Sept. '46, p. 111-113.

For certain products—particularly those requiring tubular shapes and closed ends—impact extrusion is a fast, simply tooled means of fabrication. Its essentials are only a punch, die, and press; but its potentialities range from collapsible tubes to aircraft parts.

19-213. **Experimental Research in the Cold Rolling of Metals.** High Ford. *Journal of the West of Scotland Iron & Steel Institute*, v. 52, June '46, p. 59-88.

Experimental results are presented and compared, including a short account of plant, instruments, and technique. Graphs show roll pressure vs. reduction for copper and for various steels, test properties of metals used, effect of previous working on energy consumption, effect of roll diameter on roll pressure and force, effect of speed and lubricants on roll pressure, and other factors.

19-214. **What to Look for in Purchasing an Hydraulic Press.** Earl Cannon. *Modern Industrial Press*, v. 8, Aug. '46, p. 6, 8, 38, 48.

Points out how essential it is to the pressed metal industries to have standardization in specifications.

19-215. **Two-for-One Press Operation Speeds Indianapolis-Chevrolet Body Production.** P. D. Aird. *Modern Industrial Press*, v. 8, Aug. '46, p. 13-14, 16, 34.

Rear upper lining panel of the cab is a typical example of utilizing the fullest facilities of a press in volume production by forming two of the same part on each cycle of the press. When completed, the part is 50x21 in., with a window panel opening, and formed with 18¼-in. radius at each end. The draw is a fairly deep one and it is formed from a processed sheet of body steel 51x70 in. It is held within tolerance of $\frac{1}{64}$ in. and formed for welded assembly with the other components of the truck cab.

19-216. **The Rolling of Metals: Theory and Experiment. Part XI. Spread During Rolling.** L. R. Underwood. *Sheet Metal Industries*, v. 23, Aug. '46, p. 1495-1510.

Factors affecting spread; formulas; wire flattening.

19-217. **Methods of Calculation Used in Rolling Mill Practice. Part 1.** J. H. Mort. *Sheet Metal Industries*, v. 32, Aug. '46, p. 1511-1514.

Some useful methods of establishing an accurate quantitative relationship between raw material and finished product.

19-218. **The Manipulation of Thin Gage Sheet Metal.** J. A. Grainger. *Sheet Metal Industries,* v. 23, Aug. '46, p. 1547-1553, 1568.

Blanking; cutting clearances and angles on blanking tools; size of punch and die to maintain size of product; choosing the press for blanking; bending and forming; direction of grain and hardness of material in relation to bending; kinking troubles; follow-on tools; deep drawing; punch head radii; draw edges; reverse drawing.

19-219. **Combination Method of Forging Magnesium.** A. L. Rustay and F. B. Rote. *Machinery (London),* v. 69, Aug. 1, '46, p. 129-136.

With the combination method—that is, first blocking the stock in a hydraulic press and then finishing under a hammer—forgings have been successfully produced from cast "multiples" or blanks of AZ31X, AZ61X, and AZ80X alloys. Table shows various American designations of these alloys and others mentioned, together with their composition.

19-220. **Forming of Aluminum Alloys.** *Chemical Age,* v. 55, Aug. 3, '46, p. 137-139.

Process is described in which a thick rubber pad is used as a lining to exert pressure against the work. It is suitable for rapid production of parts not needed in quantities that warrant use of hardened steel tools and dies.

19-221. **Progress in Mining Drill Steels.** L. Sanderson. *Mine & Quarry Engineering,* v. 12, Aug. '46, p. 53-55.

Recommended techniques for forging, hot milling, and heat treating of steels for use in mining drills.

19-222. **Keys Replace Pockets in Die Shoes.** Walter J. Kamp. *American Machinist,* v. 90, Aug. 29, '46, p. 85-86.

Toolsteel and milling time cut when working elements of dies are backed up by machinable keys set in shallow slots and ground to fit the supported part.

19-223. **Rolling Mill Practice.** *Metal Industry,* v. 69, Aug. 16, '46, p. 135.

Abstract of a report upon nonferrous metal rolling practice in Germany made by the Joint Intelligence Objectives Agency.

19-224. **Economic Aspects of Tube Bending.** Ralph Shaw, Jr. *Steel,* v. 119, Sept. 2, '46, p. 94-95, 144, 146.

In fabricating tubular parts, closer study may well be given to machine production as this is the one factor in costs which may be more closely controlled.

19-225. **Forging Operations.** J. A. Over. *Iron and Steel Engineer,* v. 23, Aug. '46, p. 64-67.

Basic considerations in hammer forging of steel.

19-226. **Recent Developments in Tube Reducing.** George B. Coe. *Iron and Steel Engineer,* v. 23, Aug. '46, p. 76-78; discussion p. 78.

Reviews some recent changes that have been made in the Rockrite tube-reducing machine and examines the newer products which can now be made by the process.

19-227. **Rail Straightening With a Horizontal Type Press.** Paul H. Gast. *Iron and Steel Engineer,* v. 23, Aug. '46, p. 91-94.

All operations in this press are controlled by one man; the rail may be turned and gags operated at the will of the operator at a central, convenient location, with smaller chance of injury either to operator or rail.

19-228. **The Overheating of Steel Drop Forgings.** H. J. Merchant. *Steel Processing,* v. 32, Aug. '46, p. 505-508.

Various aspects of the causes of, and factors influencing, overheating, the nature and detection of overheating, and the methods adopted to prevent and reclaim overheated forgings.

19-229. **Beading for Sheet Metal Guards.** H. F. Williams. *Machine Tool Blue Book,* v. 42, Sept. '46, p. 189-191.

Beading commonly used to trim, finish, and strengthen the raw edges of sheet metal guards, splash fenders, pans, and other sheet metal devices. Introduces and explains the prevailing practices.

19-230. **Carbide Mandrels—Their Care and Servicing.** A. E. Glen. *Machine Tool Blue Book,* v. 42, Sept. '46, p. 197-198, 200, 202, 204, 206, 208, 210.

Various types of carbide dies and mandrels for the production of tubing; they should be given the same care and consideration given any other precision tool; precautions listed.

19-231. **Deep Drawing Filter Cases. Part III. (Continued.)** Carl J. Nagel. *Tool & Die Journal,* v. 12, Sept. '46, p. 98-101.

Flange trimming, forming of vertical lip around top of filter shell and the punching of the lid fastening holes around top of the case.

19-232. **Hot Spinning Heavy Tank Heads.** Charles H. Wick. *Machinery,* v. 53, Sept. '46, p. 141-147, 173.

Modern methods of spinning steel plates, as well as other ferrous and nonferrous metals, into the many types of heads required for various applications. Finishing steps in the spinning of an oil refinery reactor head that weighs 32,450 lb.

19-233. **A 60-Ton Slab Turnover Device.** Walter H. Burr. *Iron and Steel Engineer,* v. 23, Sept. '46, p. 100-101.

Unique slab turnover mechanism solved a difficult problem in the world's largest plate mill.

19-234. **Strip Production by the Steel Company of Canada, Ltd.** Charles Longenecker. *Blast Furnace and Steel Plant,* v. 34, Sept. '46, p. 1129-1142.

The furnace; the Mesta 110-in. plate mill; treatment of plates; electrical equipment for 110-in. reversing plate mill; type of control; Mesta 56-in. strip mill; electrical equipment for 56-in. continuous hot strip mill; 250-volt shop supply for plate mill, hot strip mill auxiliaries and cranes; Ward-Leonard set for power supply to flying shear, runout tables and coilers; major auxiliary drives located outside of the main mill motor room; finishing coils and sheets; pickling and cleaning.

19-235. **Upsetting Aluminum Heads.** Harry G. Howell. *Steel,* v. 119, Sept. 23, '46, p. 108-111, 176-177.

Highly developed forging, heat treating and finishing practice is used in production of cylinder heads for radial aircraft engines.

19-236. **Successive Stage Forming for High Production of Stamping.** Charles R. Cory. *Production Engineering & Management,* v. 18, Sept. '46, p. 60-64.

Basic principles of design for multistage dies suitable for progressive forming operations on high speed, automatic, coil-fed presses and hand strip-fed machines.

19-237. **Production Processes—Their Influence on Design. XV. Shot-Peening.** Roger W. Bolz. *Machine Design,* v. 18, Sept. '46, p. 129-132.

Equipment and its operations; applications; designing for peening; materials successfully shot-peened; tolerances.

19-238. **Tooling for Specialized Hardware.** *Western Machinery and Steel World,* v. 37, Sept. '46, p. 100-103.

Procedures and equipment in plant turning out large quantities of stamped, pressed, forged and pierced items of specialized hardware for a variety of industries.

19-239. **Forging Die Design.** John Mueller. *Steel Processing,* v. 32, Sept. '46, p. 572-574.

Efficiency of a forging die is determined by production performance. Basic steps in drop hammer forging are fullering, edging, bending, roughing and finishing. Details of ring forging of gear blanks given. Recommends establishment of best technique by sawing and microetching sample forgings before going into production. Grain lines should follow contour of the forging.

19-240. **Spinning of Stainless Steel.** *Steel Processing,* v. 32, Sept. '46, p. 575-578.

The process, its advantages and limitations; design of items to facilitate spinning.

19-241. **Pulling Force and Stress Distribution in Wiredrawing.** *Wire Industry,* v. 13, Sept. '46, p. 501-502.

Development of a mathematical theory of the wiredrawing process in order to gain a better insight into the magnitude and distribution of stresses and deformations obtaining in the die and to establish the relationship of these factors with the pulling force and the drawing speed. (Translated from *Metallwirtschaft,* v. 23, '44.)

19-242. **Hot Dimpling.** *Metal Industry,* v. 69, Sept. 13, '46, p. 213-216.

Modern techniques for high-strength aluminum alloys.

19-243. **Precision Sheet-Metal Work in the Aircraft Gas Turbine.** *Aircraft Production,* v. 8, Sept. '46, p. 414-423.

Practice of Joseph Lucas, Ltd., is reviewed and some of the tooling equipment used in the manufacture of combustion chambers is described.

19-244. **Intermittent Feeding Mechanism Operating Two Slides From One Cam.** *Machinery (London),* v. 69, Aug. 29, '46, p. 270-271.

Mechanism designed to feed a continuous strip of corrugated flat wire stock through a machine for further fabrication.

19-245. **Design and Production Technique. V. Principles Involved in Pressing.** A. J. Schroeder. *Aircraft Engineering,* v. 18, Sept. '46, p. 320-323.

Applicability of hot and cold working to metals, hot working to plastics and cold working to ceramics. Hot working of metals is subdivided into nipping, clinching, and injecting. Material is presented in concise outline form and in tables and diagrams. Second part gives method for investigating costs in mass production. Third part outlines design of molds for metal, ceramic, and plastic pieces.

19-246. **Cold Bending of Pipes and Metal Shapes.** E. J. DeWitt and H. S. Nachman. *Machinery (London),* v. 69, Sept. 5, '46, p. 289-297.

Principles involved; types of machines; application of ram and rotary automatic and manually operated machines.

19-247. **Hot Dimpling. (Concluded.)** *Metal Industry,* v. 69, Sept. 20, '46, p. 238-239.

Heated die method of hot dimpling; suggests that the direct-resistance heating method is preferable.

19-248. **Elevated Temperature Stretch Flanging of Some Aluminum Alloys.** E. G. Thomsen, D. M. Cunningham, and J. E. Dorn. *Transactions of the American Society of Mechanical Engineers,* v. 68, Aug. '46, p. 643-646.

Tests to determine the stretch flanging limits of a number of aluminum alloy sheet materials at forming temperatures of 70, 300, 400, and 450° F. Spot tests were made on other variables, such as other contour diameters, sheet thicknesses and sector lengths, in order to observe the major trends introduced by these variables.

19-249. **Folding in Tube-Sinking.** George Sachs and W. M. Baldwin, Jr. *Transactions of the American Society of Mechanical Engineers,* v. 68, Aug. '46, p. 647-654.

Factors involved in the folding or collapsing of tubes being sunk studied experimentally. Variables studied are its temper, the wall thickness of the tube, and the die contour.

19-250. **Die Steels for Hot Work.** D. W. Rudorff. *Metallurgia,* v. 34, Aug. '46, p. 189-193.

Reviews a Russian and a German investigation in which possibilities were explored of limiting the percentage of tungsten in steels used for hot work dies and punches.

19-251. **Power Economy in Rolling Mills.** Y. N. Shpunberg. *Engineers' Digest (American Edition),* v. 3, Aug. '46, p. 387-398.

Methods for reducing power consumption. (Abstract from *Promishlennaya Energetika,* no. 1, '46, p. 3-5.)

19-252. **The Rolling of Metals: Theory and Experiment. Part XII.** L. R. Underwood. *Sheet Metal Industries,* v. 23, Sept. '46, p. 1699-1712.

Methods of calculating the rolling load which can be applied with a limited degree of success to cases of rolling in which spread is appreciable. Most of the examples refer to the hot rolling of steel bars or ingots.

19-253. **Methods of Calculation Used in Rolling Mill Practice. (Continued.)** J. H. Mort. *Sheet Metal Industries,* v. 23, Sept. '46, p. 1713-1718.

Calculations relating to raw material requirements for sheet mills. First step is to fix thickness limits for finished packs, then the weight per lineal foot of sheet bar is determined. Illustrated by means of examples. Also shows use of monographs for computing slab dimensions.

19-254. **Practical Problems of Light Press Work Production. (Continued.)** J. A. Grainger. *Sheet Metal Industries,* v. 23, Sept. '46, p. 1721-1727.

Effect of rubber buffers; use of cushions on double action presses; combining operations.

19-255. **The Cold Working of a High-Purity Aluminum Alloy Containing 4% of Copper and Its Relation to Age Hardening.** Marie L. V. Gayler. *Journal of the Institute of Metals,* v. 72, Aug. '46, p. 543-561; discussion p. 561-563.

Data described are based on the cold working of a high-purity aluminum, 4% copper alloy previously subjected to specific aging heat treatments. Correlation between the observed changes in hardness and the microstructure has led to further information regarding the effect of cold work on the age hardening process. Experiments were carried out in five series, in each of which all factors were constant save one, which was varied. Five series are given. Properties of the alloy after each specific treatment have been determined by microscopical analysis and Brinell hardness measurements. 22 ref.

19-256. **Shot-Peening and Its Importance in the Spring Industry.** L. J. Wieschhaus. *Wire and Wire Products,* v. 21, Sept. '46, p. 665-667, 701-703.

Advantages of shot-peening as compared to shot-blasting. Methods; tests on springs; effect on design; operating hints.

19-257. **Wire Drawing Machines—Past, Present and Future.** N. Davidson. *Wire and Wire Products,* v. 21, Sept. '46, p. 676-678, 690-698.

Review of developments from 1930 to 1946; types of machines in current use; operation of machines; practice in England, Canada, U. S., Sweden, Hungary, Rumania, and Germany; future developments. (Paper presented before the Staff School of Frederick Smith & Co., Ltd., Halifax, England.)

19-258. **Direct Resistance Heating Method of Hot Dimpling 75S-T.** T. E. Piper and Al Schoellermann. *Automotive and Aviation Industries,* v. 95, Sept. 15, '46, p. 24-26, 68.

Illustrates the machine and its equipment and gives operating details.

19-259. **High Speed Forging Increases Auto Parts Production.** Herbert Chase. *Steel,* v. 119, Oct. 21, '46, p. 98, 134, 136.

How connecting rods and other parts are forged, two

at a time, at rate of 450 per hr. on 2000-ton press. Other forgings produced on combination of upsetters, rolls and hammers.

19-260. **Tools for Use in Pipe-Bending Machines.** E. J. DeWitt and H. S. Nachman. *Machinery (London),* v. 69, Sept. 19, '46, p. 366-368.

Forms, clamping dies, stationary pressure dies, and shoes used in connection with bending machines for pipes, tubes, and other metal shapes.

19-261. **Drop Forgings for Gas Turbine Application.** Carl I. Schweizer. *Materials & Methods,* v. 24, Sept. '46, p. 642-645.

Most of the forgings used are alloy steel forgings which serve as part of the structural bracing and upon which the stresses are more or less static and fixed; disk type, or rotor forgings, which are usually formed of some special alloy possessing high strength at elevated temperatures, and which are subject to high centrifugal stresses due to their speed of rotation; and blade or bucket forgings subject to complex vibratory stresses as well as centrifugal stresses.

19-262. **The Rolling of Metals: Theory and Experiment. Part XII. (Continued.)** *Sheet Metal Industries,* v. 23, Oct. '46, p. 1901-1914, 1919.

Theories of rolling are not restricted to small contact angles and wide material (mainly hot rolling). 12 ref. (To be continued.)

19-263. **Practical Problems of Light Presswork Production. (Continued.)** J. A. Grainger. *Sheet Metal Industries,* v. 23, Oct. '46, p. 1923-1930.

Reverse drawing; examples; stress reversal; importance of lubrication. (To be continued.)

19-264. **Pressure Forming.** T. W. Elkington. *Sheet Metal Industries,* v. 23. Oct. '46, p. 1943-1950.

An efficient and economical method of producing intricate pressings.

19-265. **Aluminum Wire Fabrication.** H. S. Spaulding. *Wire and Wire Products,* v. 21, Oct. '46, p. 766-767, 844.

Rolling; wiredrawing; lubricants; die practice; heat treating; welding; annealing; applications.

19-266. **Some Unusual Conditions Encountered in Cold Heading Products.** F. W. Nobbs. *Wire and Wire Products,* v. 21, Oct. '46, p. 784-787, 790.

Trouble in driving 17 S aluminum alloy rivets because of formation ot lopsided heads was investigated by photomicrographic examination. After several unsuccessful changes, the wiredrawing practice was changed so that final draft was made after the last annealing operation. Gives details of a process for making corrosion resistant bolts and screws possessing ultimate tensile strengths of 125,000 to 145,000 psi. from KR monel metal. For improvement of fatigue and tensile properties of roll threaded steel bolts it was found that roll threading after annealing gave higher ultimate strength values than prior roll threading.

19-267. **Hydrodynamic "Fluid Punch".** *Tool & Die Journal,* v. 12, Oct. '46, p. 78-80.

Pictures, drawings, and captions tell story of the forming and embossing of shallow sweeps and shapes and the drawing of cores and tapered sections, accomplished in one operation and without use of a metal punch. Hardened aluminum alloys have been drawn into finished stampings without heat treating and re-striking. To date, stock up to $\frac{3}{16}$ in. has been worked, wrinkle-free and without fracture, but the limit in material thickness has not yet been determined.

19-268. **Die Cost Reduced With Hydrodynamic Metal Drawing.** *Production Engineering & Management,* v. 18, Oct. '46, p. 75-76.

Shows how two or more stampings can be drawn with one multiple female die utilizing a hydraulic "fluid punch" replacing the usual mechanical male die.

19-269. **Thin-Stock Dies for Secondary Operations.** Wallace C. Mills. *American Machinist,* v. 90, Oct. 24, '46, p. 102-105.

Success in beading and curling shells under 0.020 in. thickness depends on application of basic design principles for thin metal. Curling principles are illustrated for curling on the periphery and interior flanges of shells. Their embodiment in tools is shown. Beading, sizing, reducing, nib forming and threading tools are also shown.

19-270. **Sheet Perforating Press.** E. H. Edstrom. *United Effort,* v. 26, Oct. '46, p. 8, 10.

Construction and operation of a mechanical sheet perforating press with rotating feed.

19-271. **Operation of 44-In. Blooming Mill in South African Plant Conforms to Latest Practice.** *Blast Furnace and Steel Plant,* v. 34, Oct. '46, p. 1265-1270.

Details of the different ingot sizes and weights that are rolled on this mill; hearth areas and pit capacity; performance of the blooming mill as obtained by means of time studies taken on individual ingots; quality, distribution and analysis of steel rolled.

19-272. **German Methods of Tungsten and Molybdenum Wire Manufacture.** *Wire Industry,* v. 13, Oct. '46, p. 558, 566.

Report of the Field Information Agency (Technical), United States Group Control Council for Germany, shows that no real changes were discovered in the methods of extraction or purification of the oxides and metals.

19-273. **The Rolling of Strip.** *Wire Industry,* v. 13, Oct. '46, p. 564-565.

Objects of cold rolling; technicalities of rolling; defects revealed by cold rolling; annealed copper strip. (Extracts from a lecture given before the Birmingham Metallurgical Society.)

19-274. **Use and Servicing of Carbide Mandrels.** *Steel,* v. 119, Oct. 28, '46, p. 86, 88.

A few simple precautions which increase effectiveness of carbide mandrels in tube mills.

19-275. **The Effect of Peening Upon Residual Welding Stresses.** E. Paul DeGarmo, Finn Jonassen, and J. L. Meriam. *Welding Journal,* v. 25, Oct. '46, p. 616s-623s.

Severity of peening; effect of temperature of the material being peened; effect of peening the last pass of welds; peening the plate material adjacent to the weld; restraint in the plane of the plates being welded. Details of the test procedure and results of work on 29 panels.

19-276. **Pole Figures of the Effect of Some Cold Rolling Mill Variables on Low-Carbon Steel.** John Karl Wood, Jr. *American Society for Metals Preprint,* no. 11, 1946, 13 p.

Presents a quantitative picture of the orientation effects produced in cold rolled low-carbon sheet steel by changing, one at a time: total reduction at the end of each pass; roll diameter; intermittent pass versus a continuous pass; and tension on the strip. Two sets of pole figures were plotted. One in the specimen or rolling-cross rolling plane and the other in the normal-cross rolling plane with the edge of the specimen on a diameter of this figure. Pole density was plotted in four densities—dense, medium, light, and zero.

19-277. **High Speed Rolling Mills.** E. J. Wood. *Light Metal Age,* v. 4, Oct. '46, p. 13.

Brief account of new equipment in new aluminum foil plant.

19-278. **The Flexibility of Press Brake Tooling.** A. H. Blacker. *Tool & Die Journal,* v. 12, Oct. '46, p. 91-96, 98.

Press brake applicable to taper and cone forming; multiple punching, trimming and notching; embossing; corrugating and curving; notching and forming; and straightening on work of great overall length. Also allows combinations of these operations to be performed simultaneously or in sequence on the same machine. Some examples given.

19-279. **Hi-Speed Production at Ford's Ypsilanti Plant.** P. D. Aird. *Modern Industrial Press,* v. 8, Oct. '46, p. 13-14, 16, 18, 20.

Equipment and operations for manufacture of starter and generator frames.

19-280. **Forging Aluminum.** Thomas A. Dickinson. *Modern Industrial Press,* v. 8, Oct. '46, p. 30, 32, 34.

Considers both press and hammer forging processes; advantages of former. Table lists physical and chemical properties of aluminum forging alloys.

19-281. **Shot Peening of Agricultural Hand Tools.** *Steel Processing,* v. 32, Oct. '46, p. 661-662.

Union Fork and Hoe's procedure in manufacturing shovels; application of shot-peening to increase resistance to fatigue.

19-282. **Induction Heating for Forging Economy.** J. R. Coley. *Steel Processing,* v. 32, Oct. '46, p. 665-668.

Economy of induction heating; differential heating; automatic cycling; equipment needed and flexibility.

19-283. **Automatic Press Feeder Prevents Accidents.** *Iron Age,* v. 158, Oct. 31, '46, p. 56.

Consists principally of an automatically indexing table and a pivoted pick-up arm. Eight nests are placed around the outer edge of the table so arranged as to present the

parts at the correct angle for location in the die. Press is set for continuous operation, and the operator is required merely to drop the stampings into the nests as these rotate in front of him. Device has also had the effect of increasing production on one particular part from 1100 to 1800 pieces an hr., while requiring noticeably less effort on the part of the operator.

19-284. **Investigation of Roll Wear in the Hot Rolling of Wire and Strip.** R. Tosterud and E. Stenfors. *Engineers' Digest,* v. 3, Oct. '46, p. 510-512.

Influence of the roll material and its structure, of the groove shape, and of the analysis and the quantity of the material, were studied, as well as the influence of the rolling speed and of the initial height of the piece. The factors influencing roll wear and the phenomena taking place in the roll gap are discussed and evaluated. Devices used for measuring groove depth and roughness of the groove are described. Relationships between linear wear of groove and quantity of material rolled are presented graphically. Results believed useful when planning a rolling mill for a given output. (From *Jernkontorets Annaler,* v. 130. no. 6, June '46, p. 213-238.)

19-285. **Forgings and Magnesium's Tomorrow.** G. W. Motherwell. *Aluminum and Magnesium,* v. 3, Oct. '46, p. 24-25.

A few of magnesium's characteristics; development of forging techniques.

19-286. **Tough Stainless Demands Rugged Tooling.** Peter Hallin. *American Machinist,* v. 90, Nov. 7, '46, p. 101-103.

Press tonnage, ram speed, punch and die clearance and logical choice of die material decide success or failure of various press operations on stainless.

19-287. **How to Work Magnesium Alloys.** Anderson Ashburn. *American Machinist,* v. 90, Nov. 7, '46, p. 117-123.

Machining; sheet working methods; casting and forging; joining methods; cleaning and finishing. Table gives typical characteristics of magnesium alloys.

19-288. **Adjustable Spindles and Interchangeable Rolls Make Stamping Trimmer Versatile.** *Product Engineering,* v. 17, Nov. '46, p. 94-95.

A stamping trimmer that can trim almost any kind of stamping in a single plane owes its flexibility to the quickly adjustable powered spindles that can receive a wide assortment of rolls and cutter heads. Table top and spindles both have vertical adjustment to take deep stampings. Trimmer handles large or small stampings with or without flash. It cuts both steel and aluminum alloy and performs trimming, beading, forming and flanging.

19-289. **Carbide Drawing Die Practice.** Daniel Mapes. *Machine Tool Blue Book,* v. 42, Nov. '46, p. 263-266, 268, 270.

Experience in the use of Carboloy cemented carbide dies for deep drawing and why it was favored.

19-290. **Wiredrawing in England.** P. Grodzinski. *Wire and Wire Products,* v. 21, Nov. '46, p. 890-896, 905-909.

Cleaning; surface treatment and lubrication; drawing

machines and their operation; storing, loading and handling; general plant layout.

19-291. **Hot-Coiling Automotive Suspension Spring.** *Machinery,* v. 53, Nov. '46, p. 190-194.

Production methods followed by the spring division of the Eaton Mfg. Co. in converting 750 tons of steel per month into automotive suspension springs.

19-292. **Die for Making Square-Cornered, Airtight Containers in One Operation.** C. W. Hinman. *Machinery,* v. 53, Nov. '46, p. 216-217.

Airtight container is drawn and formed from a $\frac{1}{64}$-in. thick, soft, deep drawing steel blank in a single operation. Corner seams are ironed so smooth that they are not easily detected. Depth of container to be formed is limited only by the length of the press stroke.

19-293. **Workhardening and Rupture in Metals.** Lloyd R. Jackson. *Metals Technology,* v. 13, Oct. '46, T. P. 2072, 16 p.

Appraises present position with respect to the following: relative importance of shear and hydrostatic stresses in controlling plastic flow of metals and in determining amount of flow before rupture in metals; use of generalized strains in determining effect of plastic flow on workhardening of metals. 26 ref.

19-294. **Forging Alloy Steel Radial Engine Crankcases.** A. J. Pepin and A. L. Rustay. *Metal Progress,* v. 50, Nov. '46, p. 1023-1028.

Describes pictorially the principal operations in forging steel crankcases. Steel used is A.M.S. 6324, a National Emergency, chromium-nickel-molybdenum steel with hardenability approximately equivalent to the S.A.E. 4140 from which the crankcases were formerly made.

19-295. **Production Processes, Their Influence on Design. Part 17. Hot Upsetting.** Roger W. Bolz. *Machine Design,* v. 18, Nov. '46, p. 131-137.

Process and applications; design of dies and punches, design of parts for hot upsetting; materials; temperatures; tolerances.

19-296. **Better Work at Less Cost From Modern Forging Methods.** Victor Brown. *Production Engineering & Management,* v. 18, Nov. '46, p. 51-54.

Great expansion in closed-die forging since 1936. Achievements in metallurgical factors and equipment.

19-297. **Cemented Carbide Dies Establish Saving on Deep Drawing.** Daniel Mapes. *Production Engineering & Management,* v. 18, Nov. '46, p. 62-64.

Qualities of longer life and absence of surface scoring that are inherent in carbide dies are reflected in a 50% scrap reduction and a 25% production increase on deep drawing operations at Walter Kidde & Co.

19-298. **Laminated Plastic Jigs and Tools.** *Aircraft Production,* v. 8, Nov. '46, p. 513.

Advantages of laminated bakelite in drill-and-rout templets for sheet and plate details, rubber press forming tools and bending blocks. Table gives physical properties.

19-299. **Dimpling Light-Alloy Sheet.** *Aircraft Production,* v. 8, Nov. '46, p. 536-540.
Investigations into the use of high-temperature methods.

19-300. **New Method of Wire Straightening.** G. E. Shubrooks. *Materials & Methods,* v. 24, Nov. '46, p. 1230.
Straightening machine built by Hamilton Watch Co. uses hardened steel dies with an extremely high polish.

19-301. **Stamped Bushings.** D. B. Wilkin. *Steel,* v. 119, Nov. 25, '46, p. 64-66, 104.
Intricate and highly accurate progressive dies make stamping press a volume producer of tubular-shaped bushings and bearings. Steel and bronze are worked interchangeably on most setups.

19-302. **Can You Draw Aluminum?** E. V. Sharpnack. *Modern Industrial Press,* v. 8, Nov. '46, p. 22, 24-26.
Selection of the proper alloy, design of the part, and calculation of the number and type of draw operations and of blank size. (To be continued.)

19-303. **Production at Preco.** C. S. McElrath. *Modern Industrial Press,* v. 8, Nov. '46, p. 30, 32, 38.
Equipment and methods utilized in manufacturing presses and fans for railroad cars.

19-304. **A Tooling Program for Forged Globe Valves.** Carl F. Benner. *Tool & Die Journal,* v. 12, Nov. '46, p. 78-82.
Procedure followed in manufacturing the forged body of the brass offset globe valve.

19-305. **Strengthening Metal Parts by Shot-Peening.** H. F. Moore. *Iron Age,* v. 158, Nov. 28, '46, p. 70-76.
Phenomenon of metal fatigue and the effect of shot-peening thereon. Factors leading to the development of fatigue fractures and an explanation of the function of shot-peening in strengthening metals. Results of numerous fatigue tests of peened and unpeened metal are tabulated and corresponding S-N diagrams are given.

19-306. **German Bimetal Tubing.** *Iron Age,* v. 158, Nov. 28, '46, p. 76.
A process for producing steel tubing with copper or bronze plating or cladding (inside or outside or both) at a German plant.

19-307. **A Zinc-Alloy Die Foundry.** *Engineer,* v. 182, Nov. 15, '46, p. 440.
Use of Kirksite, an 83% zinc alloy, in the making of sheet metal press tools.

19-308. **Punch Press Protector.** John Isaacs. *Electronics,* v. 19, Dec. '46, p. 101-103.
When the slugs formed by a punch press are not cleared within 3 sec., an electronic timer shuts off power. In normal operation slugs evacuated through a sensing unit prevent the timer starting.

19-309. **The Rolling of Metals: Theory and Experiment. Part XIII. (Continued.)** L. R. Underwood. *Sheet Metal Industries,* v. 23, Nov. '46, p. 2105-2115.

Torque, deformation work, and rolling horsepower. (To be continued.)

19-310. **Practical Problems of Light Presswork Production. (Continued.)** J. A. Grainger. *Sheet Metal Industries,* v. 23, Nov. '46, p. 2127-2131.

Deep drawing. (To be continued.)

19-311. **Extrusion.** H. A. Unckel. *Metal Industry,* v. 69, Nov. 22, '46, p. 423-425.

Experimental work carried out on a series of alloys of copper, lead, tin, zinc. Effect of the application of an envelope of plastic metal on the development of cracks from the periphery of the rod at its exit from the die orifice is reported. (To be concluded.)

19-312. **Strengthening Metal Parts by Shot-Peening. Part II.** H. F. Moore. *Iron Age,* v. 158, Dec. 5, '46, p. 81-86.

Phenomenon of metal fatigue and the effect of shot-peening. Effect of peening on fatigue fractures in regions of high compressive stress is explored in particular detail and comments are given on the offsetting by peening of stress concentrations, holes, fillets and notches, and of decarburization. Precautions necessary to obtain optimum results with shot-peening.

19-313. **Featherweight Wheelbarrow Formed From Magnesium.** Chester S. Ricker. *American Machinist,* v. 90, Dec. 5, '46, p. 101-103.

Only three machines are required to make the Dowcraft "Lawnbarrow", a 12-lb. wheelbarrow that is all magnesium alloy except the wheel assembly and five bolts. One hydraulic press forms the hopper, another rolls its edge, a brake forms the leg and brace. Handles are bent in hand fixtures on a bench.

19-314. **Improved Methods of Armature-Core Production.** *Machinery (London),* v. 69, Nov. 21, '46, p. 657-661.

By assembling the blanked laminations strictly in the sequence of their production, the filing of armature winding slots is dispensed with. Also by using special fixtures and press tools, assembling is quicker and more accurate.

19-315. **The Manipulation of Magnesium Alloy Sheet and Extrusions.** G. Goddard. *Magnesium Review and Abstracts,* v. 6, July '46, p. 89-101.

Review of published information to August 1945 covers plastic deformation; commercial alloys; preparation of blanks for forming; preheating of blanks; drawing presses; heating and design for press tools; tool materials; lubrication; forming procedure. (To be continued.)

19-316. **Extrusion.** H. A. Unckel. *Metal Industry,* v. 69, Nov. 29, '46, p. 445-447.

Some experimental work on hot-short alloys including effect of coatings, causes of hot shortness, susceptibility to cracking, high-temperature brittleness in duralumin type alloys. 4 ref.

19-317. **Cold Reduction Reversing Strip Mill.** *Engineer,* v. 182, Nov. 29, '46, p. 493.

New 80-in. cold reduction reversing strip mill installed recently in England.

19-318. **Ingenious Work-Transfer Mechanisms for Progressive Dies.** Charles O. Herb. *Machinery,* v. 53, Dec. '46, p. 139-147, 161.

Salient features of unique dies and their feeding arrangements, designed by Ford engineers for performing as many as ten press operations with one handling of the work.

19-319. **Mill Practice—the Care and Maintenance of Dies.** R. R. Preston. *Wire and Wire Products,* v. 21, Dec. '46, p. 957-960, 996-997.

Mill layout, scheduling, cleaning, lubrication, dieroom layout and care of dies with special emphasis on last two items.

19-320. **Thread Rolling—Theory and Practice.** J. W. Batchelder. *Iron Age,* v. 158, Dec. 19, '46, p. 58-64.

Thread rollng machines and practices are explained in detail. Some of the basic concepts of thread rolling and the evolution of thread rolling equipment. (To be continued.)

19-321. **Die Erhohung der Kriechgrenze durch Kaltreckung. (Effect of Cold Working on Creep Strength.)** H. Zschokke. *Schweizer Archiv,* v. 12, Oct. '46, p. 297-304.

Effect of cold working on creep strength at elevated temperatures of three 18-8 steels containing W, Ti, Ta, Cb, and Mo. Additional tests were used to determine effect of rolling temperature on creep strength. 15 ref.

19-322. **Precision Forging of High-Temperature Alloys.** C. H. Smith, Jr. *Iron Age,* v. 158, Nov. 28, '46, p. 42-46.

Metallurgical and mechanical considerations involved together with a detailed description of the operation sequence.

SECTION XX

MACHINING AND MACHINE TOOLS

20-1. **Blind Hole Tapping.** D. V. Bell. *Screw Machine Engineering,* v. 7, Dec. '45, pp. 66-69.

Natural difficulties present when machining internal threads by tapping. Solution for some chip problems. Additional light on old problem of how coolants reach cutting tool edges, embedded with the material being machined.

20-2. **Machine of the Industry—a New Model Hardinge.** *Screw Machine Engineering,* v. 7, Dec. '45, pp. 76-79.

Describes some important operating elements and major units incorporated in design.

20-3. **A New Type Collet.** *Screw Machine Engineering,* v. 7, Dec. '45, p. 80.

Jacobs Manufacturing Co. develops chuck to accept broad range of drill sizes; chuck features neoprene inserts.

20-4. **Vertical Precision Mill.** M. C. McConnell. *Iron & Steel,* v. 18, Oct. '45, p. 454.

Production of round bars to fine tolerances.

20-5. **Machining Diesel-Engine Combustion Plugs.** *Machinery (London),* v. 67, Nov. 22, '45, pp. 561-565.

Methods employed at Works of Pavey, Paxman & Co., Ltd.

20-6. **Jigs and Fixtures Can Be Simple.** Ben C. Brosheer. *American Machinist,* v. 89, Dec. 20, '45, pp. 99-102.

Drilling, tapping, reaming and countersinking of thousands of holes to close limits at high production rates with easily operated units.

20-7. **Practical Ideas.** *American Machinist,* v. 89, Dec. 20, '45, pp. 139-144.

Semi-automatic retracting tool simplifies thread cutting. Revolving tray for gage blocks reaches everyone. Pneumatic machine does tube burring quickly and accurately. Disk holds short springs for grinding with speed and safety. Pneumatic powered bender makes hooks and collars. Universal vise holds small parts for soldering and welding. Compact lapping tool fits confined space. Sliding, double-box fixture for multi-position assembly. Tail-

stock steadyrest for steel bushing production. Combination die and beveler finishes rods in single operation. Differential gear screwdriver provides own thrust. Locomotive crankpins are step-fitted for accuracy. Sanding machine deburrs bushing faces. Compound double-eccentric cable-eye spreader.

20-8. **Pointers on Abrasive Points.** William S. Hallowell and William S. Hemsley. *American Machinist,* v. 89, Dec. 20, '45, pp. 106-109.

Close analysis of job and careful selection of wheels and points guarantee efficient and economical grinding operations.

20-9. **Wire Brushes as Production Tools.** *Tool & Die Journal,* v. 11, Dec. '45, pp. 88-89.

New power brushes are saving thousands of dollars in production costs and conserving many thousands of manhours. Tested on both long and short shafts for close tolerance operations, for removing insulation, rust, mold marks and for a large number of operations requiring deburring, cleaning or finishing small diameter inside surfaces.

20-10. **Tooling for Peace.** Nils H. Lou. *Tool Engineer,* v. 15, Dec. '45, pp. 25-27.

Photo-lofting process is simple and inexpensive to operate, assures a uniformly high quality of reproduction. Can be used for many other kinds of photo-reproduction work on metal, cloth or paper, for making nameplates and instrument panels as well as all sorts of display material, service manuals and instruction books.

20-11. **Die Sinking With Tracer Control.** Anders Jansson. *Tool Engineer,* v. 15, Dec. '45, pp. 28-31.

Universal duplicators quickly convert standard machine tools to automatic profiling.

20-12. **Trends in Broaching.** *Steel,* v. 117, Dec. 31, '45, pp. 58-61, 91.

Discusses various types of broaching and cites advantages.

20-13. **Finishing Spur Gears for Aircraft Engines.** Sidney Cornell. *Iron Age,* v. 156, Dec. 27, '45, pp. 46-50.

Discusses merits of both grinding and shaving methods of finishing aircraft spur gears, and describes principles upon which each process operates.

20-14. **Automatic Roto Shaving for Fine Surfaces.** Walter Praeg. *Iron Age,* v. 156, Dec. 27, '45, pp. 56-57.

Designed for finish machining operations on all kinds of cylindrical, flanged, and conical parts. Cutters used are similar in appearance to specially formed, fine-pitch milling cutters, number of cutters being determined by the number of surfaces to be finished in one setting, and these produce fine, spiral, hair-like chips. Cutters and work both rotate, as in grinding. With a stock removal of 0.010 in. on flanges, or 0.020 in. on diameters, rough machined parts may be finished to grinding tolerances with a fine smooth surface at least equivalent to that obtained in green grinding, the cost being quite low.

20-15. The Grinding of Cemented Carbide Cutters. Raymond O. Catland. *Western Machinery & Steel World,* v. 36, Dec. '45, pp. 538-541, 582-583.

By following method outlined, cracks will be avoided and a smooth cutting edge, good surface and consistent economical results will follow.

20-16. Grinding Hardened Steel Precision Gears. Emil A. Koether. *Materials & Methods,* v. 22, Dec. '45, pp. 1754-1758.

How to avoid cracking and improve service properties. Study of effect of grinding on gears used in aircraft engines and relative effect of grinding on endurance limit of gears and gear tooth fatigue.

20-17. "Plus" Methods Enhance Tool Life and Product Quality. E. W. Siege. *Tool Engineer,* v. 15, Dec. '45, pp. 40-41.

Coordination and follow-up minimizes tool failure and breakdown.

20-18. Belt Grinding—One of the Later Developments in the Grinding Field. W. A. Papworth. *Machinery,* v. 52, Dec. '45, pp. 155-160.

Review of applications, methods, and machines used in belt grinding, including both platen and contact-roll type of grinders.

20-19. Recent Applications of the Thread-Rolling Process. *Machinery,* v. 52, Dec. '45, pp. 161-164.

Precision threading, knurling, serrating, and burnishing operations performed at high production rates on new thread-rolling machine having several novel features.

20-20. Optical Locating System Takes Guesswork Out of Positioning. G. C. Becker. *American Machinist,* v. 90, Jan. 3, '46, pp. 83-86.

Method involving microscopes attached to special fixtures has wide field of application in precision drilling, boring, graduating and milling work.

20-21. Gear-Tooth Finish Improved by Burnishing. G. H. Sanborn. *American Machinist,* v. 90, Jan. 3, '46, pp. 88-89.

Operation is accomplished by rolling the work gear in a nest of three accurate hardened and ground gears, known as burnishing gears. They are rotated in one direction, then in the other, under radial pressure. Recommended procedures for finishing soft and hard gears.

20-22. Practical Ideas. *American Machinist,* v. 90, Jan. 3, '46, pp. 123-128.

Combined operations demonstrated with three different built-up tools. Air and oil control feeds and retracts portable drill. Adjustable jig clamps angle iron for welding frames. Interrupted-screw indicator attachment sets boring tools. Equalizing double-punch rivets fiber blocks. Floating die cleans and finishes defective molded parts. Box holds small hones for uniform dressing. Universal bracket holds grinder for facing seats and flanges. Expanding mandrel has wide adjustment range. Music wire snap-rings wound in a lathe. Electric plugs soldered with controlled current. Angle plate checks production work rapidly.

20-23. Negative Rake. *Automobile Engineer,* v. 35, Dec. '45, pp. 543-546.

Includes recommendations for machine horsepower, cutting speeds, rake angles, feeds and depth of cut. Chip breakers are also dealt with in some detail. (Abstracted from "Negative Rake Cutting" recently published by Alfred Herbert, Ltd.)

20-24. **Precision Turning.** *Automobile Engineer,* v. 35, Dec. '45, pp. 551-552.

Machine is built to a special degree of precision and includes every refinement that long experience has shown to be desirable. Is intended for use only on fine toolroom, gage and instrument turning, and should not be used for heavy stock removal. Limits of accuracy; headstock; saddle, apron and slides; feed gear box; operating convenience.

20-25. **Machinability.** *Automobile Engineer,* v. 35, Dec. '45, p. 553.

Results of tests to study machinability in all its phases, carried out at Bethlehem Steel.

20-26. **Special Attachments Speed Turbine Bucket Production.** *Iron Age,* v. 157, Jan. 10, '46, pp. 64-65.

Two-spindle head machine is used to mill the dovetail and cut off the stock, and a standard machine to mill the tenon. Special fixtures with connections into the hydraulic systems of the machines provide maticity.

20-27. **Centerless Plunge-Grinding by Controlled Cycle.** *Iron Age,* v. 157, Jan. 10, '46, pp. 70-71.

Advance of the control wheel and work on to the grinding wheel, the removal of a certain amount of stock at a predetermined rate, the ejection of the finish ground piece, and the opening up of the wheels for the reception of the next piece are all performed automatically without physical effort at any rate up to 1000 complete cycles per hr.; cites advantages of machine.

20-28. **Manipulating a Grinding Wheel to Alter Its Grinding Action.** John F. Fischer. *Machine Tool Blue Book,* v. 42, Jan. '46, pp. 137-138, 140, 142, 144.

Grinding wheels can be manipulated, within considerable limits, to give the cutting action required. This technique is helpful when exact type of wheel wanted is not available. Tells how it is done.

20-29. **Closer Dimensional Control.** Gerald Eldridge Stedman. *Machine Tool Blue Book,* v. 42, Jan. '46, pp. 149-150, 152, 154, 156.

Details of micrometer capping machine and thread lead finder, both of which have wide application in effective accuracy, speed and economy.

20-30. **Machining Large Die Blocks.** *Machine Tool Blue Book,* v. 42, Jan. '46, pp. 164, 166, 168.

Using large horizontal bar and the Kennamilling technique incorporating a new method of grinding and blade setting (which leaves the cutter body on the spindle or arbor while the used blades are replaced with a freshly ground set) operation can now be performed, not only satisfactorily as regards surface finish but also as regards time saving and above all a normal consumption of power.

20-31. **Determining Four Gear Change Gear Ratios.** John W. King. *Machine Tool Blue Book,* v. 42, Jan. '46, pp. 243-244, 246, 248, 250.

Thirteen change gears furnished with 6x36-in. Jones & Lamson automatic thread grinders for grinding leads, measured in inches, were picked so that one or more of them have numbers of teeth which are divisible by every number between one and 27 except 17, 19 and 25. One set of 13 standard change gears for the lead change gear housing includes one each of these toothed gears: 24; 30; 32; 36; 40; 46; 48; 52; 56; 60; 66; 72; 96. From these 13 change gears, may be selected gears for grinding almost any lead (in inches). Sample computations.

20-32. **Broaching Clutch Disks.** *Machine Tool Blue Book,* v. 42, Jan. '46, pp. 267-268, 270.

Clutch disks are of mild steel and are 14 in. inside diameter. Each disk is approximately 0.115 in. thick; the stack of 13 pieces, worked simultaneously, is about 1½ in. high. Tooling; machine; fixture; controls; operation; output.

20-33. **How to Select and Use Cast Iron Shanks for Cutting Tools.** *Steel,* v. 118, Jan. 14, '46, pp. 90-91, 124, 126.

Three grades of cast iron based on tensile strength which combine desirable properties and are procurable under existing ASTM specifications. Table gives specifications. Practice of fastening tool tips to high test cast iron shanks and bodies consists of machining the casting to proper shape for receiving the tip and, frequently, joining the tip and casting by furnace brazing with silver, brass or copper.

20-34. **Portable Electric Tools.** J. L. Watts. *Sheet Metal Industries,* v. 22, Dec. '45, pp. 2142-2146.

Some practical hints on maintenance and use.

20-35. **Negative Rake Cutting.** *Sheet Metal Industries,* v. 22, Dec. '45, pp. 2157-2158.

New technique with carbide tools. Advantages summarized.

20-36. **Feeding the Single Spindle Automatic.** John E. Hyler. *Screw Machine Engineering,* v. 7, Jan. '46, pp. 38-45.

Treats popular feeding methods and equipment for the Brown & Sharpe automatic.

20-37. **Production Machining for Controlled Assembly.** Frank M. Scotten. *Production Engineering & Management,* v. 17, Jan. '46, pp. 67-71.

With machines tooled for high production, Hudson Motor engineers have devised a unique system of correlating the machining of precise parts of automobile engines for final assembly operations.

20-38. **New Milling Standards Set With Novel Cutters and Methods.** *Production Engineering & Management,* v. 17, Jan. '46, pp. 72-73.

New technique permits face milling iron, steels and nonferrous alloys at unusual speeds and feeds.

20-39. **Slashing Metal Sawing Costs With Super-High Velocities.** H. J. Chamberland. *Production Engineering & Management,* v. 17, Jan. '46, pp. 74-76.

Revolutionary advances in band sawing practice have been effected through the introduction of high and super-high velocities. Speeds of 15,000 f.p.m. now are commonplace.

20-40. **Time-Saving Fixture for Form Grinding Precision Tools.** G. T. Keatley. *Production Engineering & Management,* v. 17, Jan. '46, p. 85.

Processing time and costs on precision form tools can be cut sharply through the use of a special tool grinding fixture.

20-41. **Methods and Machines for Precision Gear Checking, Part II.** John E. Hyler. *Production Engineering & Management,* v. 17, Jan. '46, pp. 86-89.

Modern equipment available for testing straight-type bevel gears, curved-tooth form bevels, skew bevels and hypoid gears described.

20-42. **Single-Point Turning Research, Part II.** Joseph F. Allen. *Iron Age,* v. 157, Jan. 17, '46, pp. 69-72.

Number of combinations of variables which may occur when evaluating cutter performance amounts to 165,888,000, considering only the major factors. Further details are given of the special equipment used in tests, and reasons given for undertaking the research.

20-43. **Designing and Using Milling Cutters and Fixtures, IV.** C. W. Hinman. *Modern Machine Shop,* v. 18, Jan. '46, pp. 164, 166, 168, 170, 174, 176, 178, 180.

Mounting the cutters; speeds and feeds; using formed cutters.

20-44. **Bullard Man-Au-Trol.** *Modern Machine Shop,* v. 18, Jan. '46, pp. 230-232, 234, 236, 238, 240, 242, 244.

An electro-hydraulic system of units which can be applied to modernize existing machine tools; now available on Bullard Man-Au-Trol vertical turret lathes.

20-45. **Automatic Size Control Achieved Electrically on Grinder.** Roger S. Pyne. *Electrical Manufacturing,* v. 37, Jan. '46, pp. 126-130, 210, 212, 214, 216.

Automatic match grinding of inner ball bearing races to outer races represents the final culmination of development of an oscillating type radius grinder with full electrical cycle control.

20-46. **New Crush-Dressing Applications.** Carl Linxweiler. *Machinery,* v. 52, Jan. '46, pp. 143-150.

Making of master crusher rolls; grinding wheels suitable for crush-dressing; materials for crusher rolls; coolants for crush-dressing grinding wheels; plunge and traverse thread-grinding and form-grinding; examples of work ground with crush-dressed wheels; grinding thread-rolling dies and chasers; grinding worms with Whitworth thread form.

20-47. **Set-Ups That Solved Nine Borizing Problems.** C. G. Nordmark. *Machinery,* v. 52, Jan. '46, pp. 162-168.

Cases chosen exemplify jobs that have basic resemblances to many others, and it is believed that the principles illustrated by these examples can be widely applied by the exercise of reasonable ingenuity.

20-48. **Oil Spray Collection on Thread Grinding Machines.** *Engineering,* v. 160, Dec. 7, '45, p. 477.

Oil mist and fumes were collected from thread grinders by hook over each machine, conducting air to special impingement-type filters. Healthier and cleaner atmosphere was maintained, and saving of oil was economic advantage.

20-49. **Milling Cast Iron With Carbide Cutters.** *Machinery (London),* v. 67, Dec. 20, '45, p. 689-697.

Types of cast iron milled and scope of investigation; some of the results on tool life; power required for milling cast iron; cost of milling; conclusions drawn from tests.

20-50. **Cylindrical Grinding Speeds of Wheel and Work.** S.S. *Machinery (London),* v. 67, Dec. 20, '45, p. 705-706.

Selecting speeds for multiple and formed wheels; cam grinding.

20-51. **Churchill Thread-Grinding Machine.** *Machinery (London),* v. 67, Dec. 20, '45, p. 707-712.

Combination of the Churchill thread-grinding machine and the Pulcrush system of wheel crushing gives a remarkable degree of accuracy in thread form. Threads down to 80 t.p.i. have been successfully produced giving a projection at 50:1 that matches a template gage within 0.0001 in. at all points.

20-52. **Selection of Industrial Diamonds.** Sheldon Booth. *Aero Digest,* v. 52, Jan. '46, p. 96, 106.

Importance of careful selective buying for specific uses, type of setting, nature of tool in which diamond is to be used, and best methods of wheel dressing with diamond tools in order to prolong life of diamond.

20-53. **Angular Milling of Light Alloy Spar Booms.** C. Monday. *Machinery (London),* v. 67, Dec. 27, '45, p. 733-735.

Angular change and operational sequence; fixture for milling the angular top faces; calculating the offsets; milling procedure; use of graph for non-uniform variation of angle with position.

20-54. **Substitution of Lower Quality Industrial Diamonds in Diamond Dresser Tools.** H. Whittaker. *Transactions of the American Society of Mechanical Engineers,* v. 68, Jan. '46, p. 35-45.

Examination and classification of industrial diamonds; grinding-wheel dresser-tool test method; wear tests on varieties of industrial diamonds.

20-55. **Measurements of Temperatures in Metal Cutting.** A. O. Schmidt, O. W. Boston and W. W. Gilbert. *Transactions of the American Society of Mechanical Engineers,* v. 68, Jan. '46, p. 47-49.

Measurements of the heat developed in a metal-cutting operation. Chip temperature is uniform at the higher cutting speeds when all other conditions are kept constant. Temperature of the tool increases with the cutting speed, and the amount of metal removed before tool failure will generally be inversely proportional to the cutting speed. 7 ref.

20-56. **Machine Tools With Hydraulic Contour Feed Drive and Hydraulic Tracer Control.** A. Dürr. *Engineers' Digest (American Edition),* v. 2, Dec. '45, p. 604-607.

Hydro-mechanical feed drive; contour feed mechanisms; hydraulic tracer control; practical applications; all-over contour milling with hydraulic feed drive. (Abstract from *Z.V.D.I.,* Feb. 3, '45, p. 57-63.)

20-57. **Abrasive Dust Collection.** C. C. Hermann. *Tool and Die Journal,* v. 11, Jan. '46, p. 84-86.

Description of single unit installation. Table of various sizes of grinding wheels with required air volume for each.

20-58. **The Tools and Techniques for the Production of Precision Gears.** *Tool Engineer,* v. 15, Jan. '46, p. 18-38.

The evolution of the gear; gear shaping—the Fellows system; bevel gear manufacture, the Gleason system; gear shaving and checking.

20-59. **Unique Grinding Attachment for Circularity Relief.** Karl Stad. *Tool Engineer,* v. 15, Jan. '46, p. 45.

Novel application of known principle greatly widens use of universal cutter grinders.

20-60. **Machining.** T. C. Du Mond. *Materials and Methods,* v. 23, Jan. '46, p. 125-129.

Control all functions; carbides offer design challenge; toolroom accuracies in the shop; thread rolling progresses; one machining operation.

20-61. **Effect of Work Position in Face Milling.** Fred W. Lucht. *Iron Age,* v. 157, Jan. 24, '46, p. 64-68.

Careful procedure employed for determining the effects of varying work positions upon tool life. (Reprinted with corrections from the Dec. 6, 1945 issue of *Iron Age.*)

20-62. **Tool Life and the Selection of Carbide.** Raymond O. Catland. *Western Machinery and Steel World,* v. 37, Jan. '46, p. 2-5, 41.

Data to aid the user in the proper selection of the grade of carbide to use.

20-63. **Economies of Milling With Carbide Tipped Cutters.** Charles H. Bodner. *Western Machinery and Steel World,* v. 37, Jan. '46, p. 14-15.

Economies may be summarized as more parts per hour; more parts per grind; reduced cutter procurement time in case of specials; longer over-all life per cutter; elimination of finish grinding operation on steel parts; shorter regrind time per cutter; reduced cost per cutter on larger sizes.

20-64. **26-In. Spur or Helical Gear Grinder.** *Western Machinery and Steel World,* v. 37, Jan. '46, p. 34-35.

Machine will handle gears up to 30 in. diameter with a maximum diametrical pitch of 2 and a minimum diametrical pitch of 12. It will handle helix angles, right or left-hand, up to 35°, and a maximum width of gear face of 10 in. Indexing means are provided for grinding gears with numbers of teeth ranging from 5 to 190, except for a few prime numbers above 83.

20-65. **Finishing Fine Bores.** *Production and Engineering Bulletin,* v. 4, Dec. '45, p. 419-423.

Some notes on the boring and honing of holes in aircraft components where a high finish and close limits on size are specified.

20-66. **Power Brushing Fixtures.** G. O. Rowland. *Steel,* v. 118, Jan. 28, '46, p. 120-182.

Special methods used to hold parts at proper angle with sufficient pressure assure satisfactory results in brushing operations.

20-67. **Cushioned Tips Extend Life of Negative-Rake Turning Tools.** W. C. Holloway. *American Machinist,* v. 90, Jan. 31, '46, p. 108-109.

With heavy copper cushion under the carbide tip, a negative-rake turning tool can be used to machine alloy steel forgings at high speed, giving finish that may avoid need for grinding. Tool loss due to cracking of tips during grinding drops and tool life shows marked increase.

20-68. **Practical Ideas.** *American Machinist,* v. 90, Jan. 31, '46, p. 115-120.

Ideas from halfway around the world. Square plate and nest lays out precision gage. Intermittent leadscrew makes double-helix worm. Air cylinders clamp long channel uniformly. Hole-saw for sheet metal utilizes old band saws. Fiber clip machined with aid of pilot pin and contour block. Ball-bearing cleaning machine accommodates assorted sizes. Dry powder molding makes carbide parts.

20-69. **Ford-Built Merlins.** J. A. Oates. *Aircraft Production,* v. 8, Jan. '46, p. 7-16.

Ingenious machines and gaging equipment. Negative rake milling and turning; heat treatment.

20-70. **Broaching Simplifies Manufacture.** *Machine Tool Blue Book,* v. 42, Feb. '46, p. 235-236.

All major machining operations on aircraft engine valve rocker arms—except the mounting bore and faces—are performed by surface broaching on dual ram machines. Operations include broaching of large flats; of smaller flat surfaces in specified angular relation to each other; of concave and convex radii, etc. Various surfaces on the right and left-hand rocker arms are broached in ten different operations (five on each arm) on five standard dual ram machines.

20-71. **New Lathes Announced by Monarch.** *Iron Age,* v. 157, Feb. 7, '46, p. 78-80.

New Uni-Mati consists essentially of two members: *(a)* A simplified version of the conventional lathe base and headstock, and *(b)* from one to three specially designed, individually motor driven tool slides mounted on swiveling bases to permit turning, facing, and boring operations from almost any angle. Moldmaker's lathe incorporates adjustable leadscrew variating mechanism to compensate for shrinkage of the material to be molded. Mona-Matic lathe designed specifically as a manual or semi-automatic machine for first or second operation work on gear blanks, straight or flanged bushings, and various types of shafts with one or more steps.

20-72. **Basic Relationship of Hypoid Gears.** Ernest Wildhaber. *American Machinist,* v. 90, Feb. 14, '46, p. 108-111.

Enlarged pinions and increased spiral angle are advantages of hypoids in automotive applications.

20-73. **Practical Ideas.** *American Machinist,* v. 90, Feb. 14, '46, p. 139-144.

Six special tools from English shops. Bench vise attachment for beading small tubes. Time and labor saved in marking out tube joints. A combined clamping and drilling grip. Improving the finish of a reamed hole. An air jet as an aid in turning internal grooves. New life for worn chasers. Milling fixture has horizontal and vertical clamping. Epicyclical rotation burrs unwieldy parts. Triple-roller burnisher prolongs lathe-life. Tail-stock couplings allow controlled power drilling. Jig-boring huge bearings in revamped lathe. Wedge type clamp disappears when not in use.

20-74. **Initial Contact of Milling Cutter and Work-Piece.** M. K. *Machinery (London),* v. 68, Jan. 3, '46, p. 1-8.

An original study of initial contact between the teeth of a milling cutter and the work being milled.

20-75. **Machining Crankshafts for High Speed Diesel Engines.** *Machinery (London),* v. 68, Jan. 10, '46, p. 37-41.

Special machines have been introduced for performing certain operations, including an interesting crankpin-turning machine, and an angular drilling machine for the oilways in the pins and journals. In the machining of the webs use is made of negative-rake milling cutters for operations which are often performed on shaping machines.

20-76. **Precautions Before Starting to Grind.** R. E. P. *Machinery (London),* v. 68, Jan. 10, '46, p. 59-60.

Importance of clean centers; proper lubrication of centers; regrinding of centers; variation in depth of center holes; care of spindle bearings.

20-77. **High Velocity Band Sawing.** H. J. Chamberland. *Automotive and Aviation Industries,* v. 94, Feb. 1, '46, p. 18-21, 58, 60.

Speeds from 50 to 15,000 fpm. may band-saw most efficiently more than 125 different materials. Tables give saw control factors for high velocity band-sawing of plywood, non-ferrous metals and plastics; saw control factors for high velocity band-sawing of steels and cast iron; high velocity band-sawing rates on materials in aircraft production.

20-78. **Fixture Design for Multiple Machining Operations.** *Die Casting,* v. 4, Feb. '46, p. 70, 72.

Only four separate setups are required to accomplish 18 machining operations. High rate of production is attained without sacrifice of close dimensional tolerances.

20-79. **Tooling the Automatic Screw Machine, XV.** Noel Brindle. *Modern Machine Shop,* v. 18, Feb. '46, p. 124-128, 130.

Drilling one or more holes on the periphery of a component with an index drilling attachment while another part is being machined in the work spindle position.

20-80. **Ideas From Readers.** *Modern Machine Shop,* v. 18, Feb. '46, p. 216, 218, 220, 222, 224, 226, 228.

Adjustable jig for use in clamping mitre corners. Convair's simple, accurate planimeter. Air-operated tailstock. Positioner for welding end rings to cage bars.

20-81. **Positioning Fixture Permits Tapping to 4½-In. Depth an Unmachined Heavy Walled Pipe.** *Steel,* v. 118, Feb. 11, '46, p. 111.

Fixture, plus slight modification of the tool holder, also has made it possible to cut full 100% threads in rough (unmachined) sections of heavy welded pipe stock.

20-82. **The Marshall Cabin-Blower.** *Machinery (London),* v. 68, Jan. 17, '46, p. 69-74.

Describes source of the machining operations on some components of the blower.

20-83. **Indexing Drill Jig for Gear-Box Body.** N. D. P. *Machinery (London),* v. 68, Jan. 17, '46, p. 75.

Indexing drill jig is used for drilling and tapping series of holes; drilling, tapping and facing other holes; worm gear-box body for which the indexing drill jig was designed.

20-84. **Indexing Base for Standard Dividing Head.** H. R. B. *Machinery (London),* v. 68, Jan. 17, '46, p. 84-88.

By means of the auxiliary indexing base described, angular setting of the dividing head can be quickly and accurately made. Shows the general design of the indexing base.

20-85. **A Symposium: The Tools and Techniques for the Production of Precision Gears.** *Tool Engineer,* v. 16, Feb. '46, p. 18-33.

Bevel gear manufacture—the Gleason system; cross axis gear shaving; the "shear speed" gear shaper; carbide hobs enhance quality and production.

20-86. **Electronics Applied to Machine Tools.** B. T. Anderson. *Tool Engineer,* v. 16, Feb. '46, p. 34-41.

Electronic "brains" control automatic cycle machines and increase production. Application of the electronically controlled, adjustable speed drives to machine tools; brief description of component parts of the drive.

20-87. **New Technique Cuts Milling Costs.** Karl Stad. *Tool Engineer,* v. 16, Feb. '46, p. 41-42.

Carbide milling cutters, even though used in old equipment, out-perform high speed steel cutters.

20-88. **The Elements of Gearing. Part 5.** *Tool Engineer,* v. 16, Feb. '46, p. 46-47.

Calculation of gears.

20-89. **New Lathe for Small Turning Work.** *Iron Age,* v. 157, Feb. 14, '46, p. 75.

Precision turret with 12 feeds, and automatic speed changes for each turret position.

20-90. **New High-Speed Milling Technique.** *Iron Age,* v. 157, Feb. 14, '46, p. 76-77.

Cutter consists of a steel or centrifugally cast iron body, conical in shape, and having two rings brazed onto the

circumference; blades are located in grooves in the body and are retained by two 5/16-in. setscrews carried in the rings. A 12% cobalt high speed steel is used, and each blade is cushioned by a strip of copper brazed on the back. In addition, each blade is copper plated all over to increase the coefficient of friction between the body and the blade, and thus to minimize the possibility of the blades slipping. It is this added friction that is largely responsible for the extremely simple design of the cutter body.

20-91. **Automatic Turret Feed Regulator for Lathes.** *Iron Age,* v. 157, Feb. 14, '46, p. 77.

Automatic turret feed regulator having automatically positioned longitudinal and cross-feed stops; illustrates a 36-in. swing machine equipped with a 24-in. hexagon turret, and having a 16½-in. spindle hole.

20-92. **Production Processes. Part VIII. Swiss Automatic Machining.** Roger W. Bolz. *Machine Design,* v. 18, Feb. '46, p. 117-122.

Wide range of generation; turret-type automatics faster; standard cams simplify design and production; attachments increase design possibilities; slotting and light milling possible.

20-93. **Automatic Broaching Slashes Processing Cost.** *Production Engineering and Management,* v. 17, Feb. '46, p. 76.

Time for cutting internal clutch disk teeth reduced 90% by replacing individual cutting with multiple broaching.

20-94. **Checking the Flat on Cutting Tools With Rolls.** Charles L. Hall. *Production Engineering and Management,* v. 17, Feb. '46, p. 91-92.

Two different methods for using rolls to calculate the width of the flat face on cutting tools. Formulas are given for checking the tool in a perpendicular position and also for checking with the tool resting on the front clearance angle.

20-95. **Wet Belt Process Doubles Product Output.** William F. Schleicher. *Production Engineering and Management,* v. 17, Feb. '46, p. 94, 96.

Wet belt machining, which has broad applicability for metal finishing, eliminates one operation formerly required and more than doubles product output obtained by other methods for high production of a precision product.

20-96. **Improved Lathe Designs Shown by Machine Builder.** *Production Engineering and Management,* v. 17, Feb. '46, p. 116-119, 190.

Monarch Machine Tool Co. announces two new turning machines, featuring semi-automatic operation and electronic control. Two improved toolroom lathes also show cost advantage.

20-97. **The Automatic Manufacturing Plant—Mass Production Shop of the Future.** Erik Oberg. *Machinery,* v. 52, Feb. '46, p. 148-155.

Building, essential equipment and unique production line features.

20-98. **Rapid Grinding of Milling Cutters for Continuous Production.** *Machinery,* v. 52, Feb. '46, p. 179.

In order to secure the results that have been obtained at the Bell Aircraft plant, it is only necessary to cut the slots in the cutter body and in the grinding body at one setting of the milling machine.

20-99. **Cam Grinding on a Cylindrical Grinder.** Frank Zagar. *Machinery,* v. 52, Feb. '46, p. 180-181.

Oscillating spindle moving toward and away from the rotating grinding wheel produces two flat surfaces and also blended curved surfaces. Cost of fixture, including engineering and toolroom time, did not exceed $400.

20-100. **Machining of Aluminum and Its Alloys.** *Light Metals,* v. 9, Feb. '46, p. 94-104.

Investigation upon the influence of tool form, cutting speed, depth of cut and allied factors upon the surface finish, output capacity and tool life, etc., when turning aluminum and aluminum-base alloys. (E. von Burg in *Schweizer Archiv,* v. 10, 1944, p. 161, and *Technische Rundschau,* no. 48 and 49, 1945.) 16 ref.

20-101. **Chromium Plating of Lathe Tools, Advantages and Limits.** H. Schallbroch and W. Hielscher. *Engineers' Digest (American Edition),* v. 3, Jan. '46, p. 33-35.

Influence of chromium plating on the efficiency of lathe tools has been examined with regard to length of tool life, tool thrust, form of chip and quality of surface. All tests were carried out by turning with ordinary straight right-hand roughing tools. (Abstract from *Z.V.D.I.,* v. 88, no. 23-24, June 10, '44, p. 321-326.) 10 ref.

20-102. **Rolls-Royce Griffon 65. Part I.** J. A. Oates. *Aircraft Production,* v. 8, Feb. '46, p. 59-73.

Sequence of operations when machining the forked connecting rod. Some of the more interesting equipment employed for crankshaft production.

20-103. **Smart Tool Engineering Speeds Up Production Grinding.** W. G. Johnson. *Steel,* v. 118, Feb. 25, '46, p. 84-85, 122.

A number of ways in which ingenuity in tool engineering contributes heavily toward efficiency in grinding operations.

20-104. **Some Effects of Work Positioning When Face-Milling Steel.** Fred W. Lucht. *Transactions of the American Society of Mechanical Engineers,* v. 68, Feb. '46, p. 151-160.

Problem of determining optimum cutter diameter for a given face-milling job, and the proper positioning of the workpiece in relation to the cutter, led to a series of studies, results of which are reported.

20-105. **A System of Multiple Measurements for Automatics.** *Screw Machine Engineering,* v. 7, Feb. '46, p. 53-57.

How many machines can one man operate? Solving the problem by finding the case facts; typical case; factors behind development of "standard rate key".

20-106. **Table of Revolutions and Cam Rise for Threaded Lengths.** *Screw Machine Engineering,* v. 7, Feb. '45, p. 64-65.

Total revolutions and cam rise can be taken directly from the table for threaded lengths up to 2 in. having from 14 to 80 threads per inch.

20-107. **Wet-Belt Machining.** William F. Schleicher. *Iron Age,* v. 157, Feb. 28, '46, p. 52-55.

For surfacing and stock removal on all types of material, the new technique of wet-belt machining offers speed, efficiency, and extreme accuracy. Surfaces machined may be flat, convex, or concave and limits of accuracy of 0.0005 in. can be held without difficulty by the use of simple, inexpensive fixtures. For less accurate work hand operations may be performed.

20-108. **Power-Feed Attachments Take Wobble Out of Hand Drilling.** E. W. Cooper. *American Machinist,* v. 90, Feb. 28, '46, p. 96-98.

Units developed to improve portable drilling operations on fighter-plane fuselage members.

20-109. **Milling Large Spar Caps With Positive Rake Cutters.** F. M. Gibian. *Automotive and Aviation Industries,* v. 94, Feb. 15, '46, p. 32-34, 106.

Spar milling machine has a cast stationary bed with moving carriage supporting two horizontal 100-hp. motors operating at 2900 rpm. and two vertical 30-hp. motors turning at 10,000 rpm. All four arbors are direct driven. Beds of the production machines are 30 ft., which allows a 22-ft. stroke. Carriage is actuated by an electronically controlled d.c. motor driving through a pinion and rack, which provides infinite variations in feed between 0 and 200 in. per min. Contouring movement of the cutters is controlled by rollers held in contact with form bars by air cylinders. Machine is designed to provide a direct one-to-one relationship between roller and cutter. In this manner the form bars are fabricated to the finished part contour dimensions.

20-110. **Field for Lathes Broadens Because Engineers Shelve Design Traditions.** Guy Hubbard. *Steel,* v. 118, March 4, '46, p. 120-121, 142, 144.

New line of turning machines grows out of recognition that completely revised standards of power, rigidity, speeds and feeds are demanded by carbide tooling; tight limits on dimensions and surface quality are here to stay; electrification involves much more than motors and push buttons, and routine repetitive operations must be transferred to mechanisms.

20-111. **Hydraulic Power.** A. H. Allen. *Steel,* v. 118, March 4, '46, p. 134, 180, 182, 184.

Power up to 5000 psi. and 40 hp. is provided by application of unusual design and construction principles in small, radial-type plunger pump.

20-112. **Tool Life and the Selection of Carbide. Part II.** Raymond O. Catland. *Western Machinery and Steel World,* v. 37, Feb. '46, p. 54-57, 96.

Designating tool life; experiences in making tool life tests.

20-113. **Latest Developments in Honing Techniques.** L. S. Martz and D. T. Peden. *Steel Processing,* v. 32, Feb. '46, p. 98-103.

New developments in the honing process provide necessary reproducibility in production processing, as related

to the final forming, sizing, and finishing of cylinder bores in power generating, power transmission, and other force and material conserving mechanisms.

20-114. **The Fly Cutter Has Its Uses.** Bartlett West. *Modern Machine Shop,* v. 18, March '46, p. 124-128, 130.

Photographs and descriptions of operations on which fly cutters are used, mostly vertical milling machines, but the tool is equally useful in horizontal machines. In all cases the blade is a toolbit, held in a special adapter attached to the machine spindle. Design of one of these holders is presented.

20-115. **Tooling the Automatic Screw Machine. Part XVI.** Noel Brindle. *Modern Machine Shop,* v. 18, March '46, p. 134-136, 138, 140, 142, 144, 146, 148, 150, 152, 154.

Machining of three components in which the use of the index drilling attachment is required. Operations are carefully analyzed to acquaint the screw machine tool engineer with an approved method of planning for the manufacture of a component in the automatic screw machine.

20-116. **Some Unusual Grinding Set-ups.** C. G. N. *Machinery (London),* v. 68, Feb. 7, '46, p. 177-180.

Arrangements to solve difficult grinding problems, or to secure faster or more accurate production.

20-117. **Thread-Grinding Practice With Single-Edge and Multi-Edge Wheels.** W. J. G. *Machinery (London),* v. 68, Feb. 14, '46, p. 211-214.

Wheels used for thread grinding; wheel hardness or grade of grinding wheels; selection of grain size for thread grinding; thread grinding with single-edge wheel; separate ribs or edges for roughing and finishing; multi-ribbed wheels; grinding threads from the solid; wheel and work speeds; truing grinding wheels by diamonds; dressing by crushing.

20-118. **Milling Cast Iron With Carbides.** Michael Field and W. E. Bullock. *Ohio State University Engineering Experiment Station News,* v. 18, Feb. '46, p. 16-23.

Preparation of cutter; work materials tested; testing procedure; scope of investigation; cost of milling. (From *Mechanical Engineering.*)

20-119. **Manual and Electric Duplicator Controls.** *Tool and Die Journal,* v. 11, March '46, p. 88-90.

By use of templates or patterns on duplicator, parts are produced in much less time, more economically and with a much higher degree of accuracy and surface finish than previously. Gorton electric control duplicators are capable of handling work from a few inches in size up to jobs weighing 3000 lb. Almost any type of job can be handled by these machines from simple profiling of production parts to intricate die sinking of the most complex shapes.

20-120. **An Outstanding Improvement in Crush Form Grinding.** *Tool and Die Journal,* v. 11, March '46, p. 92-93.

Production, dressing and reprocessing is done without removing or disturbing wheel, work or rolls, and at a great saving in crusher roll costs.

20-121. **Pump Production by Tool-Room Precision Methods.** *Machinery (London),* v. 68, Feb. 21, '46, p. 233-239.
Methods employed in McIntyre plant at Newton, Mass.

20-122. **Lathe for "Indenting".** Samuel Koffsky. *Steel,* v. 118, March 11, '46, p. 88-91, 128.
Roll grooving lathe to cut intermittent grooves or "button" forming indentations in alloy steel rolls producing two types of floor plate—a diagonal and a parallel pattern.

20-123. **Clamping Jig.** *Steel,* v. 118, March 11, '46, p. 100, 140.
Locking effect obtained by generating opposing forces in sets of mated cones.

20-124. **Making Petrol Injection Pumps.** *Automobile Engineer,* v. 35, Feb. '46, p. 55-64.
Manufacturing methods employed on some of the principal components of the S. U. single-point petrol injection pump. Unorthodox but extremely effective machining methods in connection with straddle turning operation on main body.

20-125. **Centerless Grinding.** *Automobile Engineer,* v. 35, Feb. '46, p. 68-70.
Important developments in Scrivener machines.

20-126. **Precision Boring for Obtaining Concentricity.** B. W. *Machinery (London),* v. 68, Feb. 28, '46, p. 273-276.
Examples of work and accuracy obtained.

20-127. **Borizing Set-Ups Increase Production and Accuracy.** C. G. Nordmark. *Iron Age,* v. 157, March 14, '46, p. 56-60.
Complicated boring and facing problems can be handled quickly and economically, and with the highest degree of precision, by the use of borizing equipment. Typical examples, taken from actual production practice, are described.

20-128. **Wartime Developments in British Machine Tools.** J. A. Oates. *Iron Age,* v. 157, March 14, '46, p. 61-67.
Outstanding machines developed for mass production with the use of unskilled labor.

20-129. **Thread Cutting With Dieheads. Part I.** H. Schlarman. *American Machinist,* v. 90, March 14, '46, p. 104-106.
Types of dieheads and chasers.

20-130. **Tube-Ends of ⅝ to 3-In. Diameter Beaded in Automatic-Cycle Machines.** E. W. Cooper. *American Machinist,* v. 90, March 14, '46, p. 126-128.
Operator simply inserts a tube into the clamp jaws against a stop ring and steps on the pedal of a three-way air valve. Resulting automatic cycle includes closing the clamp jaws, forward movement of the table slide carrying the beading head, and actuation of the beading spindle. Release of the valve pedal reverses the cycle, returning the machine to starting position.

20-131. **Cutter Adjusts for Slot Width.** Wilbert Radtke. *American Machinist,* v. 90, March 14, '46, p. 130.
Two blades replace four in redesign of milling cutter for rods.

20-132. **Basic Relationship of Hypoid Gears. Part III.** Ernest Wildhaber. *American Machinist,* v. 90, March 14, '46, p. 132-135.

Hypoid gears can be generated with a rotating face-mill type cutter describing a tooth of basic members which are helical segments instead of crown gears.

20-133. **Overhead Rails Overcome Awkward Positioning of Drills.** Leon Mooradian. *American Machinist,* v. 90, March 14, '46, p. 136-137.

Accurate vertical adjustment of drillheads can be accomplished by operators without a lot of wasted motions formerly demanded by the carriage machines. One or two carriages are suspended from the overhead-beam assembly. Welded steel leg assemblies at each end of the beam are on 144-in. centers, leaving about 130 in. of free track between. The bottom of the beam is 72 in. above the floor.

20-134. **Rolls-Royce Griffon 65. Part II.** J. A. Oates. *Aircraft Production,* v. 8, March '46, p. 115-124.

Machining operations on some major light alloy components, including the crankcase, cylinder head, reduction gearcase and supercharger casing.

20-135. **Modern Milling Practice.** *Aircraft Production,* v. 8, March '46, p. 125-128.

Summary of American cutter, feed and speed requirements; cutter-grinding data.

20-136. **Controlled-Cycle Centerless Grinding.** *Aircraft Production,* v. 8, March '46, p. 129-130.

Developments in thc plunge-grinding of deeply formed work.

20-137. **Modern Turret Lathes, Part I.** John E. Hyler. *Machine Tool Blue Book,* v. 42, March '46, p. 123-126, 128, 130, 132.

Types and classifications.

20-138. **Screw Products Industry Uses Compressed Air.** *Machine Tool Blue Book,* v. 42, March '46, p. 209-210, 212, 214, 216.

Variety of air applications provides an example of how a manufacturer can extend the applications of this versatile power.

20-139. **Determining Four Gear Change Gear Ratios.** John W. King. *Machine Tool Blue Book,* v. 42, March '46, p. 282, 284-285.

Method given is concerned with machine tools, which have complete, or nearly complete sets of change gears available. Large number of combinations can be determined for any given ratio. Every possible solution and approximation to a given change gear ratio can be determined.

20-140. **The Tools and Techniques for the Production of Precision Gears—a Symposium.** *Tool Engineer,* v. 16, March '46, p. 36-46.

Explains the "what", "why" and "how" of modern gear hobbing.

20-141. Tooling the Tools for Precision Manufacturing of Wobble Shaft. Harold Lundstrom. *Tool Engineer,* v. 16, March '46, p. 52-55.

Principle of using the jig borer to produce accurate angles has proved in this instance to be satisfactory, and has the further advantage that the work of the jig borer may be readily checked by the use of plugs and blocks on the master fixture. Principle of careful blank preparation leaving 0.005 in. stock allowance for finish grinding is economical in volume production, and effects maximum surface hardness in the product.

20-142. Template Grinder. *Steel,* v. 118, March 18, '46, p. 109, 159.

Has electronic control of wheel head axial traverse for precise grinding of templates and other work up to 72 in. long, 8 in. deep, and 1 in. thick, without re-positioning. Production cost is low due to the speed with which the grinding operation may be performed.

20-143. Ford's New Method of Balancing Crankshafts. Charles O. Herb. *Machinery,* v. 52, March '46, p. 156-160.

Simple improvement in the construction of standard balancing machines described expected to effect substantial savings in crankshaft balancing operations.

20-144. System for Handling Single-Point Tools at Watervliet Arsenal. E. G. Moffat. *Machinery,* v. 52, March '46, p. 161-162.

Methods adopted at the Watervliet Arsenal to promote economy in the use of cutting tools are applicable in any large industrial plant.

20-145. Jig-Boring and Jig-Grinding Machines Promote Interchangeability in Toolmaking. J. R. Moore. *Machinery,* v. 52, March '46, p. 163-166.

Lower tool and die costs and increased toolroom capacity are attained by reducing the time necessary for locating, boring, grinding, and inspecting holes.

20-146. The "Lathe Converter" Changes a Lathe Into an All-Around Machine Shop. *Machinery,* v. 52, March '46, p. 176-177.

Lathe converter consists of a basic unit by means of which milling, boring, facing, keyway cutting, and drilling operations can be performed. It is also supplied with interchangeable heads for external and internal grinding, for angular milling, and for cutting threads, worms, and screws. A broaching attachment is available for cutting internal keyways and splines, and a dividing head, mounted on the open end of the lathe spindle, makes it possible to index work.

20-147. Grinding Gages for Circular Form Tools. John J. Meadows. *Iron Age,* v. 157, March 21, '46, p. 59-60.

Grinding fixture and gage designed to determine the characteristics of the rake angles on the tools. Shutdowns for regrinding reduced to a minimum, and the life of the tools was increased by 2000% by actual count, while performance was greatly improved. System eliminated the burning of tools, produced accurate rake angles, and permitted interchangeability of tools.

20-148. **Clamping Devices for Accurately Aligning Adjustable Parts.** Louis Kasper. *Product Engineering,* v. 17, March '46, p. 216-217.

Examples of clamps for movable part to maintain accurate alignment with some fixed part.

20-149. **An Example of Mechanical Aptitude.** *Sheet Metal Worker,* v. 37, March '46, p. 43-45.

Sheet metal shop fills hurry-up order for tank top assemblies with shop-made machine composed of throw-aways—bicycle sprockets and chain, truck tire jack, auto steering wheel, etc; no factory-made machine available.

20-150. **Camless Five-Spindle Automatic.** John Parina, Jr. *Steel,* v. 118, March 25, '46, p. 90-91, 144.

Setup time reduced on new machine with quadrant linkage used to control length of feed strokes. Desired adjustment of turret and cross-slide movements is made by setting sliding block on graduated face of quadrants.

20-151. **High-Speed Friction Sawing.** H. J. Chamberland. *Steel,* v. 118, March 25, '46, p. 96-97, 145-147.

In high-speed sawing of steel, 3,240,000 saw teeth slice through tough metal at a blade velocity of 15,000 ft. per min. Suggests cost-reducing possibilities.

20-152. **Tungsten Carbide Tools.** *Steel,* v. 118, March 25, '46, p. 106, 108.

Increased productivity and efficiency resulting from adoption of tungsten carbide tools in British machine shops. Points to watch when cutting.

20-153. **Phosphor Bronze Rod in the Automatic.** Roy M. Spaulding. *Screw Machine Engineering,* v. 7, March '46, p. 44-45, 48.

Phosphor bronze bearing machined on a No. 2 Brown & Sharpe automatic. Machining routine, tool experience and recommendations.

20-154. **One Automatic—Two Different Parts.** *Screw Machine Engineering,* v. 7, March '46, p. 50-52.

Procedure whereby Lucas Screw Products, Inc., engineered out the objections into a highly productive and profitably tooled job. Machine chosen was a $\frac{9}{16}$-in. RA 6 National Acme automobile bar machine and was tooled as shown.

20-155. **The Silent Stock Tube.** *Screw Machine Engineering,* v. 7, March '46, p. 53, 55.

Tube is constructed by using a helically wound, wear resistant steel liner, placed in laminations of sound-absorbent material and encased in a seamless steel tube. No matter whether hexagonal or round bar stock is in use, the tube has proven equally effective in reducing noise.

20-156. **Die Head Mountings.** H. Schlarman. *American Machinist,* v. 90, March 28, '46, p. 108-110.

Some practical tips on how to get best results. Taper shank may not be best; engine-lathe adaptions; floating holder on tailstock; use of internal trip.

20-157. **War Turns a Page in Machining.** John Haydock. *American Machinist,* v. 90, March 28, '46, p. 113-128.

War and postwar innovations that are available to metalworking plants. Over-all trends in speeds and feeds; control; flexibility; multiple operation; accuracy; service and maintenance; safety. Specific operations: turning; grinding; milling; threading; gear cutting; broaching; drilling; planing.

20-158. **How to Get Best Results From the Jig Borer.** Julius W. Stedenfeld. *American Machinist,* v. 90, March 28, '46, p. 130-134.

Best methods of doing precision jig boring. Sketches clarify various steps. Many small things, which for ordinary work and tolerances can be overlooked, must be taken into consideration when doing precision boring.

20-159. **How the Russians Lap Carbides.** *American Machinist,* v. 90, March 28, '46, p. 138.

Chemical-mechanical process developed that laps the surfaces of a number of inserts at once. Hard material is not overheated and a flat matte surface is produced which is ideal for brazing and permits the ready detection of microcracks or other imperfections. Carbide tools fitted with bits surfaced by the new method have been found to have more cutting life.

20-160. **Practical Ideas.** *American Machinist,* v. 90, March 28, '46, p. 139-144.

Built-up milling machine for large light work. Regrinding broken-off end mills in two steps. Flash remover for moldings and die castings. Heavy metal hinge prevents buckling of H-beams. V-block aids centering in four-jaw chuck. Depth scriber made from old micrometer. Bracket circle-burner cuts ellipses at any bevel. Turning a small rod from beryllium copper. Shear-blade inserts simplify regrinding. Emergency pipe tap meets the deadline. Adjustable straightedge checks squares.

20-161. **"Push Rods" Volume Production in Precision.** P. D. Aird. *Modern Industrial Press,* v. 8, March '46, p. 13-14, 16, 20.

Gives step-by-step procedure for production of more than 75,000 every 24 hr. at Rouge plant of Ford Motor Co.

20-162. **Modern Turret Lathes, Part II—Operating Equipment.** John E. Hyler. *Machine Tool Blue Book,* v. 42, April '46, p. 123-126, 128, 130, 132, 134.

"Electric machines" with multiple-speed motors mounted directly on the spindles. Geared heads; spindle drives incorporating variable-speed transmissions. Speeds and feeds.

20-163. **Boston and Maine Shops Well Tooled.** Howard Campbell. *Modern Machine Shop,* v. 18, April '46, p. 124-130, 132.

Special "shop-designed" tools add to efficiency of equipment.

20-164. **Designing and Using Milling Cutters and Fixtures. Part VI.** C. W. Hinman. *Modern Machine Shop,* v. 18, April '46, p. 162-164, 168, 170, 172, 174, 176, 178, 180.

Advantages of index bases; fixtures for straddle-milling; swing milling; milling cam lobes.

20-165. **Ideas From Readers.** *Modern Machine Shop,* v. 18, April '46, p. 204, 206, 208, 213-214.

Multiple tooling on a planer. Lifting device for cylindrical objects. Multimandrel. Fluting a spiral tapered reamer. Safety in soldering live wires.

20-166. **Milling Steel With Carbide-Tipped Cutters of Simple Design.** *Machinery (London),* v. 68, March 7, '46, p. 307-308.

Simple fly cutters tipped with steel-cutting cemented carbide are capable of doing the work of expensive multiblade milling cutters of high speed steel and of conventional design. Shows such a cutter milling a steel block requiring a section to be cut with 4½-in. internal radius and a design using these shear angles in a simple steel-cutting fly-cutter tipped with carbide.

20-167. **Drives for Flywheel Machine Tools.** *Machinery (London),* v. 68, March 7, '46, p. 313-314.

Characteristics and comparative curves of Hyslip motor and of standard and Tork types.

20-168. **Stainless Steels.** *Automobile Engineer,* v. 36, March '46, p. 124-126.

A consideration of modern machining practice.

20-169. **Slotting Marine Bearings on Special Planer-Type Milling Machine.** *Machinery,* v. 52, April '46, p. 151.

Planer-type milling machine designed and built by the Ferry Machine Co. for machining dovetail slots in propeller-shaft bearings used in naval and commercial ships. Rubber-bonded brass strips are inserted in the milled slots to form a bearing on which the shaft revolves.

20-170. **Carbide Milling Cutter Data Calculating Chart.** *Machinery,* v. 52, April '46, p. 173-176.

Instructions for finding cutter speed, table feed and approximate horsepower.

20-171. **Boring Machine Tool Castings for Antifriction Bearings.** *Machinery,* v. 52, April '46, p. 179-180.

Use of radial drilling machine for precision boring.

20-172. **New Tooling and Assembly Methods Increase Production Efficiency.** Frank M. Scotten. *Production Engineering and Management,* v. 17, April '46, p. 67-71.

Air ejection, ingenious fixtures, automatic loading on press work, and progressive assembly operations boost output and reduce costs at Penn Electric Switch Co.

20-173. **Checking the Radius on Cutting Tools With Rolls.** Charles L. Hall. *Production Engineering and Management,* v. 17, April '46, p. 78.

Explains the application of given formula when checking radius on round nose tools.

20-174. **New Methods Speed Machining of Power Transmission Equipment.** *Production Engineering and Management,* v. 17, April '46, p. 79-90.

Increasing gear output and quality by clever tooling and refined design; increase of 40% in casting yield is obtained from centrifugally pouring parts that were formerly static cast; machine time on planer operation reduced 50% by

the addition of a special fixture and the use of a long table; machining time on a repetitive boring operation cut 60% by the use of special power units and new fixtures.

20-175. **Precision Equipment for Checking Involute Gears.** John E. Hyler. *Production Engineering and Management,* v. 17, April '46; p. 91-92, 94.

Precision equipment for checking and recording the involute profile of splines, spur and helical gears.

20-176. **Diehead Troubles and Maintenance.** H. Schlarman. *American Machinist,* v. 90, April 11, '46, p. 108-109.

Suggests various causes of trouble affecting operation of diehead; failure in unlocking; yoke design.

20-177. **Practical Ideas.** *American Machinist,* v. 90, April 11, '46, p. 143-148.

Production-developed fixtures with general-purpose applications. Sine bar vise dresses surface grinding wheels. Indexing head for continuous precision link boring. Rigid deep hole wiggler gages long cylinder bores. Plastic locking rings simplify assembly and repair operations; Spaghetti cutter makes plastic tubing cutting easy. Clock spring prevents floating lathe dogs. Lathe mandrel for concentric and eccentric turning. Radius-turning tool that's quick to make.

20-178. **Angle-Setting Vice for Tool Grinding.** A. R. S. *Machinery (London),* v. 68, March 21, '46, p. 373-374.

Inexpensive piece of equipment helps in simplifying and speeding up supply and maintenance of special tools which require a high degree of accuracy.

20-179. **Automatic Crankshaft Lathes.** *Steel,* v. 118, April 15, '46, p. 97, 145.

More automatic, and faster than prewar predecessors, four improved lathes perform essential turning operations on crankshafts with utmost efficiency.

20-180. **On the Art of Cutting Metals.** Orlan W. Boston. *Mechanical Engineering,* v. 68, April '46, p. 302-304, 313.

Emphasizes need for continuous and coordinated research in metal cutting, pointing the development in tools, metals, increased cutting speeds and cutting fluids.

20-181. **Experiences With Carbide-Tipped Tools.** M. E. Feldstein. *Mechanical Engineering,* v. 68, April '46, p. 307-313.

Describes application of carbide-tipped tools to machining landing-gear struts for aircraft, with steels of aircraft quality, machined both in the normalized and hardened state, with machining conditions running as high as Rockwell C-42.

20-182. **Rounding Effect in Centerless Grinding.** Albert H. Dall. *Mechanical Engineering,* v. 68, April '46, p. 325-329.

Advantages of centerless method; mathematical relations; additional rounding factors; problems in rounding.

20-183. **Special Machine Utilizes Combination Drives.** F. J. Kampmeier. *Machine Design,* v. 18, April '46, p. 101-106.

Milling machine combines electrical, hydraulic and mechanical power.

20-184. **A Carbide-Tipped Gear Hob Designed for Phenolic Laminates.** Raymond Nauth. *Tool & Die Journal,* v. 12, April '46, p. 84-86, 102-103.

Tungsten carbide blanks pressed at 60 tons per sq. in. or more were used. Amount of work produced between regrinds of tungsten carbide hobs as compared to high speed steel hobs is multiplied many times. Initial cost of the tungsten carbide hob is about three times that of a high speed steel hob, but a production of 40 times the previous volume is attained.

20-185. **Surface Broaching Valve Rocker Arms.** H. H. Gotberg. *Machinery (London),* v. 68, March 28, '46, p. 401-403.

Five dual-ram surface-broaching machines, arranged in a U-shape, are used to machine the various surfaces on the right and left-hand rocker arms in ten different operations, five operations being performed on each arm. Each broach takes roughing and finishing cuts. Broaching machines employed all have a 5-ton rating and a 54-in. stroke, the machines handling the first operation on both the right and left-hand rocker arms being located at the base of the U. One ram is used for broaching the right-hand rocker arm, and the other for the left-hand rocker arm.

20-186. **Flat Form Contours.** *Steel,* v. 118, April 22, '46, p. 86, 134.

New crush grinder employs "reference" roll to true up work-crushing roll without disturbing wheel, work or rolls. All equipment is table mounted for absolute alignment in producing flat form contours.

20-187. **The Efficient Control of Twist Drills.** H. Moore. *Aircraft Engineering,* v 18, March '46, p. 103-104.

Notes on some of the difficult problems in drilling that beset the fitter.

20-188. **Lapping Diesel Fuel Injectors.** Fergus Anderson. *Machinery (London),* v. 68, April 4, '46, p. 439-440.

Method of lapping whereby only one gage is used as a standard for the sizing of the male laps. Female laps are then made to be a fit on the male laps, and it follows that the components lapped must then fit each other.

20-189. **Eliminating Costly Burring Operations.** W. D. Rodney. *Screw Machine Engineering,* v. 7, April '46, p. 49-53.

By the resourceful use of the available standard attachments for automatic screw machines, many parts may be completed in the automatic, rather than resorting to the use of costly secondary operations.

20-190. **Wide Forming on a Multiple Spindle Screw Machine.** *Screw Machine Engineering,* v. 7, April '46, p. 54-58.

Possibilities of "wide forming in an automatic" as a general application method of manufacture. Benefits are: elimination of a secondary operation; less gaging of parts; percentage of scrap reduced. The sixth position support which made wide form tool application possible, has other applications such as knurling or numbering;

the added support to the wide form toolholder in the first position could also be used as a support to the cross slide to prevent chatter if necessary.

20-191. **Cross Slide Knurling for Brown & Sharpe Automatics.** *Screw Machine Engineering,* v. 7, April '46, p. 60-63.

Knurling on the automatic screw machine can be applied by the following methods: *(a)* top, bottom and side knurling from the cross slides; *(b)* adjustable turret knurling; *(c)* swing knurling, employing the combined use of both turret and cross slide operations.

20-192. **Tavannes Single-Spindle Swiss-Type Automatic.** *Screw Machine Engineering,* v. 7, April '46, p. 71-75.

Design features depart from those generally familiar in automatic screw machines. Specifications and major characteristics of individual construction units.

20-193. **Spar-Boom Production.** R. R. Noland and F. M. Gibian. *Aircraft Production,* v. 8, April '46, p. 172-175.

Milling the Northrop P-61 wing spar; flash welding nacelle spars.

20-194. **Tool Life and the Selection of Carbide.** Raymond O. Catland. *Western Machinery and Steel World,* v. 37, April '46, p. 166-169, 208.

Surface speed selection; carbide grade selection.

20-195. **Tooling the Ryan FR-1 Fireball.** William P. Brotherton. *Western Machinery and Steel World,* v. 37, April '46, p. 174-177, 203.

Tells how Ryan Aeronautical Co. solved tooling problem of designing and building the tools for an experimental airplane and then getting it into production in the shortest length of time.

20-196. **Carbide Turning With Negative Rake Angles.** Raymond O. Catland. *Western Machinery and Steel World,* v. 37, April '46, p. 188-189, 208.

What can be accomplished with the use of small negative angles applied to turning.

20-197. **Latest Developments in Honing Techniques.** Lawrence S. Martz and Douglas T. Peden. *Western Machinery and Steel World,* v. 37, April '46, p. 192-195; also *Western Metals,* v. 4, April '46, p. 15-18.

New developments in the honing process provide the necessary reproducibility in production processing, as related to final forming, sizing, and finishing of cylinder bores in power generating, power transmission, and other force and material-conserving mechanisms.

20-198. **Friction Cutting With the DoAll Zephyr.** *Western Machinery and Steel World,* v. 37, April '46, p. 196-197.

Steel panels, pens, bins, wings, steel springs, gates and risers, structural shapes of all types of steel are economically handled using the DoAll Zephyr friction saw. Armor plate ¾ in. thick cuts easily at the rate of 13.84 lineal in. per min. Thicker sections 6 and 7 in. are cut quickly and efficiently by using a "rocking technique."

20-199. **Speed and Feed Selection in Carbide Milling With Respect to Production, Cost, and Accuracy.** Hans Ernst and

Michael Field. *Transactions of the American Society of Mechanical Engineers,* v. 68, April '46, p. 207-215.

Findings of a research on milling cast iron with carbide-tipped cutters in addition to those presented previously in 1945 by Michael Field and W. E. Bullock. Work done with multitooth cutter. Comprehensive account given of the recent studies, illustrated by numerous test curves, and a practical analysis of milling costs.

20-200. **Analysis of Initial Contact of Milling Cutter and Work in Relation to Tool Life.** M. Kronenberg. *Transactions of the American Society of Mechanical Engineers,* v. 68, April '46, p. 217-228.

Methods for determining readily the impact conditions for any shape of the cutting edge as a function of positive and negative rake angles, corner angle, cutter diameter, position of the cutter relative to the workpiece, feed per tooth, and depth of cut. Tests indicate a variation in the wear of sintered carbide tools with a variation of impact conditions obtained by altering the relative position of cutter and work.

20-201. **Modern Flat Surface Grinding Practice.** J. C. Arndt and W. S. Hallowell. *Machinery,* v. 52, May '46, p. 168-172.

Types of surface grinding machines, the design of parts for surface grinding, and materials that can be surface ground.

20-202. **Grinding Lathe Tools to Eliminate Chatter.** C. W. Christiansen. *Machinery,* v. 52, May '46, p. 174-176.

Change in tool shape can often reduce and in a great many instances eliminate chatter.

20-203. **Diamond Tooling for Bearing Surfaces.** Christopher H. Bierbaum. *Modern Machine Shop,* v. 18, May '46, p. 198, 200, 205-206, 208, 210, 212, 214.

For highest possible results, an exceedingly sharp tool is essential and the final finishing should be done by taking one or, if necessary, several very light cuts. Point is illustrated by two photomicrographs, both having the same magnifications (100 diameters) and made upon the same piece of metal.

20-204. **Modern Engraving Methods and Equipment. I.** John E. Hyler. *Modern Machine Shop,* v. 18, May '46, p. 124-130, 132, 134.

Outline of the various types and kinds of operations for which the engraving machine is ideally suited and the types and kinds of machines available for these operations.

20-205. **Mockups Cut Time and Headaches.** Chester S. Ricker. *American Machinist,* v. 90, May 9, '46, p. 116-118.

Models of wood, plywood, plaster and clay expedite production of patterns, dies, jigs, fixtures, and avoid errors in hard-to-explain dimensions and sections.

20-206. **Principles Controlling the Sharpening of Radial Chasers.** H Schlarman. *American Machinist,* v. 90, May 9, '46, p. 133-136.

Efficient cutting action is largely dependent on a cor-

rect chamfer grind which involves a thorough knowledge of chamfer clearance angles and bearing.

20-207. **Practical Ideas.** *American Machinist,* v. 90, May 9, '46, p. 139-144.

Compound die forms dynamotor coils to fit restricted space. One-piece straight-shank adapter improves fly-cutter. Producing continuous threads in widely spaced holes. Checking vertical attachment with relation to work table. Handy ball turner from drill bushing. Toggle principle twice used for wide range stand clamp. Drilled and tapped frame halves notching time. Cut-away V-block eases screw thread inspection. Smoother avoids blots in correcting drawings. Riveting T-beam without bending. Carbide teeth improve circular saw. Three-stage positioning assures accurate punching. Quick-acting self-aligning toolmaker's drill vise. Hardwood block makes simple spring winder. Tailstock boring tool has simple adjustment.

20-208. **The Accurate Production of Spiral Mills.** K. S. Molnar. *Machinery (London),* v. 68, April 18, '46, p. 497-503.

Prevention of back cut. Influence of helix angle and cutter radius; methods of reducing effective diameter of cutter; method of graphical projection; alternative simple method.

20-209. **Relief Grinding Attachment Extends Tool Life and Cuts Salvage.** Paul A. Saari. *Production Engineering & Management,* v. 17, May '46, p. 71-72.

Employing a unique principle for transmitting cam motion to slide, this form relief grinder is adjustable to any combination of end and side relief.

20-210. **Broaching Applicability Extended by New Developments.** Russell A. LaCombe. *Production Engineering & Management,* v. 17, May '46, p. 73-76.

Broaching will produce more pieces per hour than does any conventional method of stock removal. By proper design of tools and fixtures and selection of the right type of machine, the process will yield accuracy of the order demanded in modern interchangeable manufacture. Overall economy is exceptionally high. Some examples of accelerated output and reduced costs.

20-211. **Chip Conveyer Eliminates Manual Handling.** R. K. Parker. *Production Engineering & Management,* v. 17, May '46, p. 89-90.

Radically new type of conveyer for chip removal virtually eliminates manual handling of chips and makes available more floor space for machine operations.

20-212. **Air-Operated Fixtures.** S. Johnson, Jr. *Steel,* v. 118, May 13, '46, p. 95-96, 154-155.

Safer, faster production and labor economy are among advantages of automatic and semiautomatic fixtures and controls.

20-213. **Acme-Gridley "Chuck-Matic".** *Screw Machine Engineering,* v. 7, May '46, p. 59-62.

"Chuck-Matic" designed for peacetime production conditions; design highlights of the "Chuck-Matic"; "Chuck-

Matic" tool-slide design; chuck, spindle speeds, high and low speed cams; safety features.

20-214. **Handling Single-Point Tools at Watervliet Arsenal.** E. G. Moffat. *Mechanical Engineering,* v. 68, May '46, p. 415-418.

System has eliminated the tool-handling problems encountered in the previous system and has resulted in the machine operator's receiving a better tool. After the new system was installed, the total tools in circulation dropped to 3500 from over 5000, and the cost of the setup and rearrangement was rapidly written off.

20-215. **Data on Production Runs With Carbide Milling Cutters.** A. O. Schmidt. *Mechanical Engineering,* v. 68, May '46, p. 427-431.

Tests performed on a production machine handled by the regular operator using run-of-the-lot production workpieces. Comparison data concerning three types of cutters used during investigation.

20-216. **Chucks and Allied Equipment.** John E. Hyler. *Machine Tool Blue Book,* v. 42, May '46, p. 127-140.

Additional facts about operating equipment. Illustrations of several typical lathes with unusual and interesting design features.

20-217. **Production Processes—Their Influence on Design. Part XI. Contour Sawing.** Roger W. Bolz. *Machine Design,* v. 18, May '46, p. 117-122.

With plain contour band sawing it is possible to produce at low cost from a single block of steel high-strength complex parts. Likewise, it is possible to produce blank parts in quantities from 1 to 500 pieces, eliminating the usual blanking die costs. Intricate shapes are cut with the same ease as simple ones.

20-218. **New Chucking Machine.** *Steel,* v. 118, May 20, '46, p. 111, 163-164.

Operates automatically to attain high-speed production on castings, forgings and tubing parts up to 12 in. diameter. Designed for all-carbide tooling.

20-219. **The Tools and Techniques for the Production of Precision Gears. The Grinding of Gears.** Gunnar Skog. **The Tools for Gear Checking.** Anders Jansson. *Tool Engineer,* v. 16, May '46, p. 26-33.

Brief résumé of gear grinding and comparison of what may be termed soft finishing and the grinding of hard gears. History of gear inspection tools and description of present equipment, including variable-center machines for checking center distances of spur and helical gears, hand rolling fixtures for bevel gears, machines for involute profile checking and for normal pitch and space inspection, electric recorders, and fixtures for checking hobs, formed cutters and gear shaper tools.

20-220. **Formula for Circular Form Cutters.** Theodore Weber, Jr. *Tool Engineer,* v. 16, May '46, p. 40-41.

Simple approach to calculation of diameters of circular form tools.

20-221. **Practical Precision in Miniature.** Harry S. Wharen. *American Machinist,* v. 90, May 23, '46, p. 103-107.

Hamilton Watch, American Bosch and Kollsman Instrument combine to reveal secrets involved in drilling 0.004-in. holes and tapping 0.008-in. ones to ultraclose tolerance in production.

20-222. **Vibration Detective at Work.** Rolland C. Griffith. *American Machinist,* v. 90, May 23, '46, p. 114-115.

Cause of chatter in machine tools; methods of elimination. Eight typical examples. (From paper for Westinghouse Machine Tool Forum.)

20-223. **More About Radial Chaser Sharpening.** H. Schlarman. *American Machinist,* v. 90, May 23, '46, p. 143-147.

Conditions of light and heavy bearing, how to recognize the troubles and how to correct them; some other phases of sharpening; precautions to be observed.

20-224. **Practical Ideas.** *American Machinist,* v. 90, May 23, '46, p. 149-155.

Two broaching fixtures for special work. Trigonometry versus micrometer stops in turning and facing. Tranfer punch makes alignment marks. Pneumatic plunger dislodges small press parts. Bench tool for precision center punching. Adjustable internal limit gage measures ball races.

20-225. **Form Grinding by Crush Dressing.** C. Linxweiler. *Machinery (London),* v. 68, May 2, '46, p. 553-559.

Making of master crusher rolls; grinding wheels suitable for crush dressing; materials for crusher rolls; coolants; plunge and traverse grinding; examples of work ground with crush-dressed wheels; grinding thread-rolling dies and chasers; other applications.

20-226. **Wedged and Clamped-Tip Carbide Tools.** N. E. Hodge. *Machinery (London),* v. 68, May 2, '46, p. 561-563.

Attachment by wedging or clamping rather than by brazing or welding of cemented carbide tips onto cutters or turning tools cuts down grinding time.

20-227. **Bullard Man-Au-Trol—a Completely Automatic Machine-Tool Control.** *Machinery (London),* v. 68, May 2, '46, p. 569-571.

Electrohydraulic system that provides automatic performance of 39 separate functions.

20-228. **Machining Magnesium.** Gilbert C. Close. *Light Metal Age,* v. 5, May '46, p. 8-10.

Experience acquired in the Northrop shops which have dealt with every conceivable machining problem from wing spars to minor fittings.

20-229. **Elimination of Vibration in Machine Tools.** Rolland C. Griffith. *Tool & Die Journal,* v. 12, May '46, p. 111-113, 125-126.

Vibration chatter marks; elements of vibration; tool and work vibrations; shock vibration; pulsation energy; motor mounts; analyzing vibration problems. (From paper for Westinghouse Machine Tool Forum.)

20-230. **Machining Stainless Steels.** J. Woolman. *Iron and Steel,* v. 19, May '46, p. 179-182.

Practical results of tests on free-cutting qualities show that the previously accepted difficulties of machining the austenitic stainless steels are not entirely a function of their work hardening characteristics, but can be related to the strong chip formation which does not readily clear from the cutting edge of the tool. Sawing, turning, drilling and tapping tests were made.

20-231. **Alignment Chart for Cutting Speed.** F. Jones. *Machinery (London),* v. 68, May 9, '46, p. 602-603.

A compact, ready-reference chart for speeds with diameters. Factors in alignment are diameter, peripheral feet per minute, and revolutions per minute. To read any concomitant particulars a straight edge is used.

20-232. **Diamonds as Cutting Tools.** J. R. Roubik and J. P. Bunce. *Steel,* v. 118, June 3, '46, p. 111, 154-155.

Three categories of industrial diamonds; uses of diamond tools.

20-233. **Practical Applications of Adjustable Voltage Drives.** W. B. Wigton. *Steel Processing,* v. 32, May '46, p. 291-297.

Table gives calculation of time saved by use of adjustable voltage drive instead of a.c. squirrel cage motor drive on vertical boring mill table drive.

20-234. **Tool Life and the Selection of Carbide.** Raymond O. Catland. *Western Machinery and Steel World,* v. 37, May '46, p. 214-217, 252.

Carbide selection for milling duralumin; carbide grade selection for stainless steel; rake angle selection; rake angle selection for S.A.E. 1020 steel, for 410 stainless steel and for duralumin.

20-235. **The Care and Servicing of Carbide Mandrels.** Ray D. Mack. *Western Machinery and Steel World,* v. 37, May '46, p. 226-229.

Hints on use and care of carbide mandrels compiled in the interest of increasing the service life of the mandrels, obtaining better inside finish on the tubing, maintaining closer tolerances on long runs, providing more continuous operation, and decreasing rejections.

20-236. **Carbide Mills Aluminum Alloys.** G. R. Gwynne. *American Machinist,* v. 90, June 6, '46 p. 106-107.

Conclusions regarding the high-speed milling of aluminum alloys derived from wartime experience in machining wing and empennage spar caps.

20-237. **How to Sharpen Tangent Chasers.** H. Schlarman. *American Machinist,* v. 90, June 6, '46, p. 133-138.

Principles of tangent chasers, with and without helix, and their practical application.

20-238. **Practical Ideas.** *American Machinist,* v. 90, June 6, '46, p. 139-144.

Microscope guard and graduated minute scale for Vinco head. Half-punching one member eliminates dowel pins. Tap wrench has built-in jackknife tightener. Single-screw triple roller burnisher. V-block fixture holds round and square stock. Ring-drilling machine employs high-speed air turbine. Lathe attachment measures awkward jobs. Another micrometer lapping block. Adjusting wedge for

heavy-duty sine bar. Pivoted V-block aligns round work on sine bar. Quick-acting chuck for boring bevel gear hubs.

20-239. **Machining of Aluminum Alloys. I and II.** *American Machinist,* v. 90, June 6, '46, p. 145, 147.

Properties having a bearing on machinability are given. These vary considerably with the different alloys. Tables give typical tool designs and machining data.

20-240. **Friction Cutting.** *Aircraft Production,* v. 8, May '46, p. 244-248.

Some operational data on an unconventional process using a hand saw running at high speed.

20-241. **German Airframe Tooling.** *Aircraft Production,* v. 8, May '46, p. 250.

Blanking and forming; assembly fixtures; master tooling.

20-242. **Recommended Speeds and Feeds for Drilling Operations.** L. G. Blumenbaum. *Production Engineering & Management,* v. 17, June '46, p. 73-74.

Basis of charts is a definite relation between drill diameter and feed. Elapsed time, feeds and speeds given are not necessarily the ultimate in economy but are safe starting points and of value in estimating.

20-243. **Precision Production With Semiportable Grinders.** Harry L. Wardrip. *Production Engineering & Management,* v. 17, June '46, p. 75-77, 79.

Precision grinding attachments enable high production at low cost with inexperienced manpower.

20-244. **Increasing Production With Carbide Tool Inserts.** R. J. Rousseau. *Steel,* v. 118, June 10, '46, p. 92-93, 137, 140, 142.

Use of carbide-tipped tools by East Springfield Westinghouse plant ups tool life 1000%.

20-245. **Surface Grinding With Cylinder and Segmental Wheels.** J. C. Arndt and W. S. Hallowell. *Machinery,* v. 52, June '46, p. 158-163.

Types of machines used and examples of work ground with cylinder and segmental wheels.

20-246. **Present-Day Motor Drives and Other Electrical Equipment for Machine Tools.** G. A. Caldwell. *Machinery,* v. 52, June '46, p. 164-168.

Review of electric motor drive equipment for special machine tool requirements.

20-247. **Friction Band-Sawing of Hard Materials.** Charles H. Wick. *Machinery,* v. 52, June '46, p. 169-171.

Principal difference between friction and conventional band sawing is in speed of blade travel, the friction bandsaw blade traveling up to nearly 3 miles per min. While the ordinary saw cuts chips, the dry friction saw blade develops enough frictional heat in the cut to soften material, and teeth of the blade carry this softened material out of the cut. Some deposits on the lower wheel guard.

20-248. **Some Considerations in Internal Grinding.** *Machinery,* v. 52, June '46, p. 172-173.

Rules for making changes in grinding wheel and work spindles to suit individual work; three types of wheelheads for holding grinding wheels normally used for the internal grinding of small holes; importance of correct lubrication of the spindle.

20-249. **Equipment Designed to Facilitate the Use of Diamond Tools.** G. Schlesinger and D. F. Galloway. *Machinery,* v. 52, June '46, p. 179-181.

Makes possible movements of turning and boring tools, and provides accurate means for control and measurement of the movements.

20-250. **Engraving Machines and Work. II.** John E. Hyler. *Modern Machine Shop,* v. 19, June '46, p. 124-130, 132.

Engraving letters, figures and other characters; uses of masters; three-dimensional work.

20-251. **Removing Broken Tools by Cutting Away Cores.** *Machine Tool Blue Book,* v. 42, June '46, p. 163-164, 166, 168.

Method permits removal without distortion in any way of threads or the hole itself and without affecting the temper of the basic part; accomplished without specialized personnel and without complicated equipment. Drill press, water outlet and an electric connection are all that are needed to make apparatus function.

20-252. **One Company's Trend in Machine Tool Wiring Methods.** A. L. Krause. *Machine Tool Blue Book,* v. 42, June '46, p. 237-238, 240, 242, 244, 246, 248, 250-251.

Enclosures conduit wiring and solenoids; general investigations on terminal joint insulation.

20-253. **Adjustable Voltage Drives — Case Histories and Practical Applications.** W. B. Wigton. *Machine Tool Blue Book,* v. 42, June '46, p. 253-256, 258-260, 262-265.

Use on the vertical boring mill. Standard of performance for an ideal drive and close approach by adjustable voltage table drive.

20-254. **Disconnect Circuit Breakers for Machine Tool Control.** H. D. Dorfman. *Machine Tool Blue Book,* v. 42, June '46, p. 267-270, 272-275.

Explains the difference between thermal, thermal-magnetic, straight magnetic, and nonautomatic breakers and where each is used.

20-255. **Honing for Precision and Production.** L. S. Martz. *Steel,* v. 118, June 17, '46, p. 112-113, 140.

Newly developed honing equipment insures close tolerance accuracy, size control, surface quality, rapid stock removal and longer tool life.

20-256. **Special Undercutting Operation on the Automatic Screw Machine.** F. W. Moritz and W. D. Rodney. *Screw Machine Engineering,* v. 7, June '46, p. 50-52.

One of the many uses to which the combined motions of turret and cross slide can be applied in the manufacture of screw machine products.

20-257. **Experiences With Carbide-Tipped Tools.** M. E. Feldstein. *Tool & Die Journal,* v. 12, June '46, p. 82-87, 142-145.

Studies undertaken to get more production per ma-

chine-hour in the machining of landing-gear struts with steels of aircraft quality, machined both in the normalized and hardened state, with machining conditions running as high as Rockwell C-42.

20-258. **Duplicating With the Keller From Gypsum Cement Models.** E. H. Schleede and E. R. Geiger. *Tool & Die Journal,* v. 12, June '46, p. 88-92.

The Keller automatic toolroom machine is a specially designed profile milling machine. It is equipped with a tracer mechanism which controls the relative movements of the cutter and the work.

20-259. **Electric Controls Applied to Machine Tools.** B. P. Graves. *Tool Engineer,* v. 16, June '46, p. 18-22.

Drives and controls on standard machine tools, with special adaptations to standard machines, as seen from the machine tool builder's angle.

20-260. **Hydraulic Controls and Drives.** L. R. Twyman. *Tool Engineer,* v. 16, June '46, p. 23-27.

A fundamental approach to the principles and advantages of hydraulics as a power medium.

20-261. **Research in Tool Engineering.** O. W. Boston. *Tool Engineer,* v. 16, June '46, p. 31-39.

Cutting forces and power requirement for machine tools; planing with dynamometer; turning with dynamometer; turning with wattmeter; lathe efficiency; tool life of tools when turning a steel with different heat treatments; developments in making and applying cutting tools; application of cutting fluids; drilling with dynamometer and wattmeter; slab milling with three-component dynamometer and wattmeter; research in grinding and grinding compounds.

20-262. **A New "Tool of Today" Meets Postwar Production Demands.** A. E. Rylander. *Tool Engineer,* v. 16, June '46, p. 40.

Named the "Chuck-matic", a new 12-in. capacity single-spindle automatic chucking machine, announced by the National Acme Co., is a radical departure from previous single-spindle chuckers.

20-263. **Top Surface Speeds on Tough Alloys With Negative-Rake Carbide Tools—1.** W. L. Sandham. *American Machinist,* v. 90, July 4, '46, p. 87-89.

Experimental project determines tool design, depth of cut, speeds and feeds for maximum surface speed on high-carbon, high-chromium alloy with negative-rake tooling.

20-264. **Transfer Machine Uses 152 Tools.** *American Machinist,* v. 90, July 4, '46, p. 116-118.

Refrigerator-compressor bodies are mass-produced in a special 24-station unit that processes the workpieces automatically to a predetermined machining cycle.

20-265. **Thread Cutting With Dieheads. 9. Methods of Thread Gaging.** H. Schlarman. *American Machinist,* v. 90, July 4, '46, p. 119-123.

One of the first things to do when diagnosing thread trouble is to make a thorough check of the gages and be absolutely sure they are right. Good threading starts and finishes with the gage.

20-266. **Machining of Aluminum Alloys—V & VI.** *American Machinist,* v. 90, July 4, '46, p. 131-133.

Sawing, drilling and reaming.

20-267. **Some Notes on the Development of Thread Grinding.** *Industrial Diamond Review,* v. 6, June '46, p. 168-171.

Abstracted from "Thread Grinding—an Interesting Part of Its History and Development", issued by Coventry Gauge & Tool Co., Ltd., 44 p., 1946.

20-268. **Friction Sawing—Past and Present.** James M. Lewis. *Iron and Steel Engineer,* v. 23, June '46, p. 81-90; discussion p. 91-93.

Principles of the process and some of its applications.

20-269. **Air-Powered Assembly Tools.** *Steel,* v. 119, July 1, '46, p. 100-102, 148.

Domestic appliances are turned out by Apex with aid of numerous compressed air devices, on both production and assembly lines. Methods reduce rejects caused by inaccuracy and operator fatigue.

20-270. **Duplex Trunnion Fixtures.** *Steel,* v. 119, July 1, '46, p. 104-105, 119-120.

Extreme precision in multiple drilling, boring and hole machining operations is achieved by unusual fixtures which permit working all six faces of part in single setup. Tolerances of a few 10,000ths are easily handled in regular production.

20-271. **Tool Life and the Selection of Carbide.** Raymond O. Catland. *Western Machinery and Steel World,* v. 37, June '46, p. 90-93, 132.

Illustrates and discusses following tests: feed per tooth; tool life vs. peripheral relief angle (P.R.A.); tool life vs. face cutting edge angle (F.C.E.A.); tool life vs. peripheral cutting edge angle (P.C.E.A.).

20-272. **Modern Engraving Machines and Methods, III.** John E. Hyler. *Modern Machine Shop,* v. 19, July '46, p. 124-132.

Applications and advantages of portable engraving machines.

20-273. **Principles of Metal Cutting. Part I.** M. Eugene Merchant. *Die Casting,* v. 4, July '46, p. 58-60.

Geometry of cutting forces and forces which are exerted on the cutting tool by the chip and the work; how these are related to the geometry of the tool-chip-work system and to one another.

20-274. **Wet Belt Machining.** William F. Schleicher. *Steel,* v. 119, July 8, '46, p. 95, 114, 117.

New wet belt machining method permits grinding, surfacing and removal of stock from any ferrous or nonferrous metal, plastic, ceramic, wood composition materials and glass without distortion, discoloring, warping, and without weakening the structure of the material. Forming of burrs caused by grinding heat is absent. Applicable to production runs involving removal of flash, fins, sprues and parting lines used for surfacing or preparing surfaces parallel to other surfaces to any desired finish. Tool, die, repair, and maintenance departments utilize speed and

accuracy of wet belt machining on chamfering, rounding, and squaring operations to limits of tolerance within ±0.001 in.

20-275. **Ford Cylinder Sleeve Production Embodies Unique Engineering Ideas.** Charles O. Herb. *Machinery,* v. 52, July '46, p. 139-147, 157.

Sleeves pass through a series of nine drawing operations, three trimming operations, six washing machines, three heat treating furnaces, an automatic storing machine, and several flanging operations, all without being touched by human hands. Step-by-step procedure from point where the blanks are received from press shop to the final inspection bench is described. Line is set up to turn out 5000 finished sleeves per 8-hr. shift.

20-276. **Machining Stainless Steel Valves.** A. P. Nelson. *Machinery,* v. 52, July '46, p. 148-153.

Recommended practices and tools for turning, drilling, and threading stainless steel parts, and the coolant employed in machining operations.

20-277. **Surface Grinding With Periphery of Straight Wheels.** J. C. Arndt and W. S. Hallowell. *Machinery,* v. 52, July '46, p. 169-173.

Typical examples of grinding of flat surfaces with straight wheels.

20-278. **Gisholt Two-Element Unbalance Measuring and Correcting Equipment.** *Machinery,* v. 52, July '46, p. 198-200.

Balancing equipment that records the amount of unbalance in automotive crankshafts and automatically transmits the recorded information to a multiple drilling machine which drills holes in the crankshafts to the depth required to effect balance.

20-279. **Ten Maxims for the Prevention of Grinding Accidents.** A. J. S. *Industrial Diamond Review,* v. 6, May '46, p. 135-138.

Lists and discusses safety rules for use of various kinds of grinding wheels.

20-280. **Symposium on Machinability.** *Machinery (London),* v. 68, June 6, '46, p. 730-733.

Abstract of "Machinability and Structure of Ferrous Materials", by C. Sykes, presented before Institution of Mechanical Engineers. Includes discussion of physical basis and testing methods.

20-281. **Cushions for Carbides.** A. W. Ehlers. *Tool & Die Journal,* v. 12, July '46, p. 80-83.

Trial and error methods using actual records of tool life between grinds show definite relationship must exist between the negative relief and the cushion braze if exceptional tool life is to be expected.

20-282. **Unusual 20-Gang Cutter and Air Lock Fixture Speeds Machining of Extruded Dural.** W. M. Nonamaker. *Tool & Die Journal,* v. 12, July '46, p. 90-93.

Possibility of chip congestion overcome by using high-pressure fluid and carefully staggering position of the cutters. A chip catcher and strainer also designed and built to separate chips from fluid.

20-283. **Optical Measuring System Assures Permanent Accuracy.** *Tool & Die Journal,* v. 12, July '46, p. 94-95.

Jig borer, known as Hydroptic-B, on which reaming, facing, chamfering, and milling can be performed, in addition to regular drilling and boring operations ordinarily done on jig borer.

20-284. **Machinability.** *Aircraft Production,* v. 8, July '46, p. 321-323.

Some important aspects discussed at the Conference organized by the Institution of Mechanical Engineers. Covers chip formation; tool materials; tool wear as a measure; production economy.

20-285. **Unit Construction for Jigs and Fixtures.** *Aircraft Production,* v. 8, July '46, p. 324-329.

Wharton universal system for experimental and production tooling.

20-286. **Machining Engine Valves. Part I. Three Exhaust-Valve Stages.** *Aircraft Production,* v. 8, July '46, p. 335-342.

Unusual procedure of using five-spindle automatics for most of the machining operations on the inlet and exhaust valves.

20-287. **Miller for Slotting Marine Bearings.** *Steel,* v. 119, July 15, '46, p. 103, 144.

Special planer-type machine designed to dovetail slots in propeller-shaft bearings for naval craft has yet to turn out its first reject in four years of service.

20-288. **Forty Years' Progress in Cutting Tools.** J. H. Barber. *Institution of Mechanical Engineers Proceedings,* v. 154, June '46, p. 18-21.

A review of developments of toolsteels and cutting tools since 1900.

20-289. **Lower Costs With Better Techniques.** *Production Engineering & Management,* v. 18, July '46, p. 66-72.

Production figures, methods, and tooling are covered in this description of plant operations which include broaching, boring, turning, cleaning, drilling, grinding, heat treat, assembly.

20-290. **Press Operation Clears Bottleneck.** John E. Capell. *Production Engineering & Management,* v. 18, July '46, p. 80.

Production of a small ordnance part made from Naval bronze and to fairly close tolerances increased from 8 to 36 pieces per hour by changing from a lathe to a press operation.

20-291. **Thread Rolling in Aero-Engine Production.** *Machinery (London),* v. 68, June 13, '46, p. 745-751.

Workpiece is supported on a rest which is similar to that employed on a centerless grinding machine. Blank is positioned between the two threaded forming rolls, one of which (that at the left-hand side) revolves about a stationary axis, while the other, which is carried by a hydraulically operated slide, is fed inwards to engage the workpiece, and to apply the pressure necessary to produce the threads. As soon as the thread has been formed to full depth, the moving roll returns to its starting position.

20-292. **Combination Machine for Many Varied Operations.** *Machinery (London),* v. 68, June 13, '46, p. 753-754.

Machine tool combines vertical milling, side milling, end milling, drilling, reaming and boring operations, so that one side of the work to be machined is completed with one clamping on the table. All feeds are controlled hydraulically, with positive locating stops for each operation.

20-293. **Symposium on Machinability.** *Machinery (London),* v. 23, June 13, '46, p. 758-761.

Abstract of "The Mechanics of the Cutting Operation" by R. N. Arnold and G. A. Hankins. Further discussion at sessions of the symposium held by the Institution of Mechanical Engineers.

20-294. **Conference on Machinability.** *Engineering,* v. 161, June 14, '46, p. 569-570.

A continuation of a report of the discussion which formed part of the Conference on Machinability held at the Institution of Mechanical Engineers in London. Theoretical relations, importance of friction, classification as "free", "medium" or "difficult" tests on cutting fluids.

20-295. **Machinability and Structure of Ferrous Materials.** C. Sykes. *Engineering,* v. 161, June 14, '46, p. 573.

The effect of variations in microstructure of a metal on the factors tool wear, chip behavior, surface finish, power absorption, etc., can be deduced in a qualitative manner from a consideration of the mechanism of the cutting operation. (Paper contributed to Conference on Machinability held at the Institution of Mechanical Engineers, London.)

20-296. **Machinability and Structure—Nonferrous Metallurgy.** A. J. Murphy. *Engineering,* v. 161, June 14, '46, p. 573-574.

Types of crystal structure encountered in the nonferrous industrial metals in connection with machining enumerated. A correlation of machinability with crystal structure is only conjectural at present. (Paper contributed to Conference on Machinability, held at the Institution of Mechanical Engineers, London.)

20-297. **The Mechanics of the Cutting Operation.** R. N. Arnold and G. A. Hankins. *Engineering,* v. 161, June 14, '46, p. 574-576.

Actual cutting is the result of rather complicated stress distribution. The mechanism of cutting is intimately associated with the known characteristics of deformation and failure under load. (Paper contributed to Conference on Machinability held at the Institution of Mechanical Engineers, London.)

20-298. **Tooling for Tapers.** John J. Meadows. *Iron Age,* v. 158, July 18, '46, p. 68-72.

Careful analysis of the available tolerances together with correct taper forming procedures can result in a minimum of 80% acceptable parts.

20-299. **Milling-Cutter Design for Continuous Production.** Arthur A. Schwartz. *Mechanical Engineering,* v. 68, July '46, p. 608-610.

Describes system developed at Bell Aircraft.

20-300. **Conference on Machinability.** *Engineering,* v. 161, June 21, '46, p. 593-594.

Discussions of the papers on cutting conditions and their effects, and machinability in relation to economy of production, which were presented at the Conference on Machinability held at the Institution of Mechanical Engineers, London.

20-301. **Standardization of Tools for Machinability Tests.** C. H. Booth. *Engineering,* v. 161, June 21, '46, p. 595-596.

It is probable that the divergent conditions which have to be met in tooling operations are the reason why it is impossible to assess the machinability of a material for all cutting operations from the results obtained from a machinability test employing only one type of cutting tool. (Paper for Conference on Machinability held by Institution of Mechanical Engineers, London.)

20-302. **Tool Materials.** J. E. Attwood. *Engineering,* v. 161, June 21, '46, p. 596.

The factors governing the selection of material for tools are: material and condition of bar or component to be machined; quantities of components required; rate of production—speeds and feeds; coolants and lubricants available. (Abridgment of paper contributed to Conference on Machinability, held at the Institution of Mechanical Engineers, London.)

20-303. **Machinability Testing Methods Using Pendulum Machines.** A. S. Kenneford. *Engineering,* v. 161, June 21, '46, p. 599-600.

Oxford-Airey pendulum machine; Leyensetter double pendulum; investigatory work by the Armament Research Department. (Abridgment of paper contributed to Conference on Machinability held at the Institution of Mechanical Engineers, London.)

20-304. **A Universal System of Jig and Fixture Construction.** *Engineer,* v. 181, June 21, '46, p. 561-562.

By this new method of construction jigs and fixtures are built up from a series of standard elements, made to precision limits, each of which is designed to perform some definite function within the jig structure. The parts are machined to very close limits and their various features have definite known dimensional relationships to one another.

20-305. **Symposium on Machinability.** *Machinery (London),* v. 68, June 27, '46, p. 817-818.

Abstracts of "The Effect of Speed, Feed and Angle on Machinability" by W. Whitworth Taylor, and of "Machinability in Relation to Economy on Production in Heavy Engineering" by G. M. Baker, presented before Institution of Mechanical Engineers.

20-306. **Top Surface Speeds on Tough Alloys With Negative-Rake Carbide Tools—II.** W. L. Sandham. *American Machinist,* v. 90. July 18, '46, p. 112-116.

For mass-production application of negative rakes, the practical maximum surface speed must be a compromise between labor costs and tool life. At present, 750 surface ft. per min. is the top practical speed.

20-307. **Thread Troubles and How to Cure Them.** H. Schlarman. *American Machinist,* v. 90, July 18, '46, p. 137-140.

Causes of thread taper; effects of heavy bearing; causes of off-form; drunkenness; poor finish; cutting lubricants.

20-308. **Practical Ideas.** *American Machinist,* v. 90, July 18, '46, p. 144-148.

Brazing and soldering copper on spot welding equipment. Automatic tool undercuts threaded-hole bottoms. Lathe dog-leather belt spring winder. Cemented carbide jaws give feed fingers long life. Quick-change boring bar holder doubles for lathe turret. Double lugs clinch four parts without fasteners. Dial attachment gages longitudinal lathe feeds from the rack. Rule of thumb calculation sets cutter grinders. Tapered spring plunger drives snap rings. Quick-opening boring mill toolholder. Fiber ladle-grip simplifies one-man ladle handling. Chip breaking grooves aid spline broaching.

20-309. **Machining of Aluminum Alloys—VII and VIII.** *American Machinist,* v. 90, July 18, '46, p. 149-151.

Tapping and threading and filing of aluminum alloys. Tables give recommendations for tapping and filing.

20-310. **Air-Operated Magazine Attachment for Secondary Operation Work.** L. W. Richart. *Screw Machine Engineering,* v. 7, July '46, p. 45-47.

By adaptation of air as a loading device for magazine work secondary operation was cut down to a minimum for machine time and operator attention.

20-311. **Quantity Production of Multidiameter Parts on Standard Lathe.** Robert S. Gans. *Screw Machine Engineering,* v. 7, July '46, p. 55-58.

Suited for both long or short runs, the Swisformer is easily installed or removed, and can be stored when the lathe is needed for other work. It forms any part from a needle point to ⅝ in. o.d., and from ¼ in. to 6 ft. in length. Previously ground stock is not required; production is fast and accurate on stainless steel, ordinary cold-rolled, brass, aluminum, etc.

20-312. **Haskins Electric Air-Controlled Tapping Machines.** *Screw Machine Engineering,* v. 7, July '46, p. 59-62.

Outstanding features of model U. T. electric air-controlled tappers include: new frame design, air-operated worktable adjustment, more sensitive air regulation and control, greater accessibility, ease of adjusting control units, and new principle of piston and air cylinder construction.

20-313. **Machinability in Heavy Engineering Production.** G. M. Baker. *Engineering,* v. 161, June 28, '46, p. 605.

Gives increase in machining cost over mild steel; comparative rates of metal removal (turning). (Abridgment of paper contributed to Conference on Machinability held at the Institution of Mechanical Engineers, London.)

20-314. **Machinability in Medium Engineering Production.** L. Johnstone. *Engineering,* v. 161, June 28, '46, p. 606.

Mainly a discussion of costs. (Abridgment of paper contributed to Conference on Machinability held at the Institution of Mechanical Engineers, London.)

20-315. **Machinability in Light Engineering Production.** P C. Redwood. *Engineering,* v. 161, June 28, '46, p. 606-607.

The most obvious advantage of increased machinability is that higher rates of speed and feed can usually be employed. (Abridged paper contributed to Conference on Machinability held at the Institution of Mechanical Engineers, London.)

20-316. **Modern Turret Lathes. Part IV.** John E. Hyler. *Machine Tool Blue Book,* v. 42, July '46, p. 153-154, 156, 158, 160, 162, 164, 166, 168.

Special types and equipment.

20-317. **Speeding Grinding Setups.** Karl F. Kirchhofer. *Machine Tool Blue Book,* v. 42, July '46, p. 205-208, 210, 212.

Holding devices.

20-318. **Thread Cutting With Self-Opening Die Heads.** G. E. Mager. *Machine Tool Blue Book,* v. 42, July '46, p. 217-218, 220, 222-224, 226, 228.

Discusses thread cutting difficulties caused by one or a number of different factors resulting in much lost production time and scrap.

20-319. **Practical Applications of Adjustable Speed Drives.** B. T. Anderson. *Machine Tool Blue Book,* v. 42, July '46, p. 245-248, 250-256, 258.

Production increases as high as 48% are possible when electronically controlled, adjustable speed motor drives are applied to lathes and milling machines. Four typical machining operations wherein this drive is used are discussed.

20-320. **Cutter Life as Affected by the Mounting of Cemented Carbide Blanks.** Fred W. Lucht. *Steel,* v. 119, July 22, '46, p. 80-83, 126.

Tests show that based on averages the brazed tip runs about 20% longer than the mechanically held tip before it reaches the failure point; the brazed tip design gives consistently longer runs than the mechanically held tip design even though in some cases the maximum length of runs for both designs was identical; the brazed tip design gives more consistently uniform results since there is a minimum difference between the longest and the shortest runs when compared with the mechanically held tip design.

20-321. **New Grinding Wheel Dresser.** *Western Metals,* v. 4, July '46, p. 37.

Features forced-feed lubrication to save bearings.

20-322. **The Wharton System of Jig and Fixture Construction.** *Machinery (London),* v. 68, June 20, '46, p. 785-789.

Jig or fixture is built from number of standardized elements which are designed to fulfill specific functions. When no further immediate use is required of fixture, it can be dismantled and parts used for another tool. Elements in general are of hardened and ground steel, and basis of system is that they are made to specified dimensions held to gage limits of accuracy. Three series of elements are employed—heavy, medium and light. These are all interchangeable.

20-323. **Symposium on Machinability.** *Machinery (London)*, v. 68, June 20, '46, p. 792-796.

Abstracts of three papers presented before the Institution of Mechanical Engineers. "Tool Wear as a Measure of Machinability", by C. Eatough; "Testing Methods Using Pendulum Machines", by A. S. Kenneford; "A Tentative Method of Assessment of Machinability", by C. W. George; discussion.

20-324. **Tool Life and the Selection of Carbide. (Continued.)** Raymond O. Catland. *Western Machinery and Steel World*, v. 37, July '46, p. 95-99.

Tool life vs. nose radius (corner radii); limiting feeds per tooth (chip thickness).

20-325. **Abrasive Belt Grinding. Part I.** *Steel*, v. 119, July 29, '46, p. 78-81, 120-121.

Fast equipment especially designed for grinding and polishing stainless steel sheet and strip; modifications for internal grinding and polishing; billet grinders.

20-326. **The Wharton Jig and Fixture System.** *Engineering*, v. 161, June 28, '46, p. 608-610.

System consists of using a number of standardized precision units to build up jig and fixture structures of varying size and shape, according to the type of work involved. These structures can be dismantled so that the units become available for further use.

20-327. **The Effect of Speed, Feed, and Angle on Machinability.** W. Whitworth Taylor. *Engineering*, v. 161, June 28, '46, p. 620-622.

As the angle increases, both the force of shear and the force of friction became smaller, as does the total work. Speed increase, feed increase, rake angle increase, all result in increase in shear angle. (Abridgment of paper contributed to Conference on Machinability held at the Institution of Mechanical Engineers, London.)

20-328. **Tool Wear as a Measure of Machinability.** C. Eatough. *Engineering*, v. 161, June 28, '46, p. 622-623.

Tool life has an important bearing on the economy of production, and the investigation was an attempt to deduce the machinability of materials by measuring the amount of wear on cutting tools of predetermined shape after operating on the materials under certain set conditions. (Abridgment of paper contributed to Conference on Machinability, held at the Institution of Mechanical Engineers, London.)

20-329. **Flexibility in Small Lot Production Broaching.** *Tool Engineeer*, v. 16, July '46, p. 29-32.

Universal fixtures and advanced methods effect marked economies in short run production.

20-330. **Shape Turning on a Lathe.** Kermit T. Kuck. *Tool Engineer*, v. 16, July '46, p. 33-36.

Intricate shapes, including ovals and irregular contours, formed with exact duplication on automatic form-turning machine.

20-331. **Balanced Production With a Tool of Today.** A. E. Rylander. *Tool Engineer*, v. 16, July '46, p. 45.

Productive rate of 30 or more six-throw crankshafts tested and corrected per hour, within tolerances of 0.2 oz-in. on equipment consisting of two electrically connected machines—one a balancing machine and the other a special multiple spindle drilling machine.

20-332. **New Lathe Produces Precision Lead Screws.** H. E. Linsley. *Iron Age,* v. 158, Aug. 1, '46, p. 58-59.

Production of precision lead screws as long as 15 ft., and with total lead error not exceeding 0.0075 in. is made possible by a special lathe recently introduced by Monarch. Feature of machine is the Variator, a device which permits selective endwise movement of the machine's own lead screw to correct lead errors during the final cut.

20-333. **Broaching Practice.** E. Percy Edwards. *Machinery (London),* v. 69, July 4, '46, p. 14-17.

Essentials of broaching tools, their care and use; material hardness.

20-334. **Processing and Fabrication of Stainless Steel Sheet and Plate Products. Part VII. Machining of Chromium-Nickel Materials.** H. S. Schaufus and J R. Federline. *Steel Processing,* v. 32, July '46, p. 448-452, 464.

Machining operations most frequently applied for stainless steel sheet and plate products are covered. By using recommended tools and practices, fabricators will obtain favorable results and avoid disappointments experienced by operators who did not appreciate nature of stainless steels.

20-335. **Wet Belt Machining.** William F. Schleicher. *Modern Machine Shop,* v. 19, Aug. '46, p. 124-132, 134, 136.

Lowered manufacturing costs are available through the low cost of jigs and fixtures, reduction in loading, machining, and unloading time, and the adaptability of the machine to a wide variety of operations.

20-336. **Planing With Carbide Tools.** *Modern Machine Shop,* v. 19, Aug. '46, p. 162, 164, 165, 168, 170, 172, 174, 176.

Carbide tools have been used regularly at the Warner and Swasey plant for routing planing of such ferrous castings as turret lathe pedestals, cross slides and cross slide carriages, tables and bases for precision threading and tapping machines. Tables given for planing horizontal surfaces, vertical surfaces, V's, dovetails from the solid, and slots.

20-337. **Abrasive Belt Grinding.** *Steel,* v. 119, Aug. 5, '46, p. 128-130, 176-177.

Several types of machines utilizing this process are becoming increasingly popular in many industrial plants. Various applications are covered.

20-338. **Recent Research in Metal Machining.** D. F. Galloway. *Institution of Mechanical Engineers Proceedings,* v. 153, War Emergency Issue no. 4, '45, p. 113-127.

Chip formation analysis; action of cutting fluids; rough machining operations; finish turning.

20-339. **Drawing Office Specification.** H. J. Griggs. *Institution of Mechanical Engineers Proceedings,* v. 153, War Emergency Issue no. 10, '45, p. 339-340.

Methods of defining surface finish on drawings. (Paper for Symposium on Surface Finish.)

20-340. **Requirements in Surface Finish.** D. McConnell. *Institution of Mechanical Engineers Proceedings,* v. 153, '45, War Emergency Issue no. 10, p. 341-342.

Requirements of surface finish are concerned with the reduction of wear, and final decisions must largely rest on the observed results of work with known surface finishes. (Paper for Symposium on Surface Finish.)

20-341. **Surface Finish in Production Methods.** W. E. R. Clay. *Institution of Mechanical Engineers Proceedings,* v. 153, '45, War Emergency Issue no. 10, p. 342-343.

Grinding; honing; superfinishing; lapping. (Paper for Symposium on Surface Finish.)

20-342. **Results of Modern Practice.** F. Nourse. *Institution of Mechanical Engineers Proceedings,* v. 153, '45, War Emergency Issue no. 10, p. 344-345.

A review of various methods used to obtain high quality surface finishes on metals. (Paper for Symposium on Surface Finish.)

20-343. **Continuity in the Production of Specified Surface Finish.** E. Swain. *Institution of Mechanical Engineers Proceedings,* v. 153, '45, War Emergency Issue no. 10, p. 345-347.

Observations deal with finishes obtained with standard equipment; they do not refer to superfinishes obtained with special equipment designed solely for the refining of surfaces obtained by present standard practice. (Paper for Symposium on Surface Finish.)

20-344. **Selecting Grinding Wheels.** John F. Fischer. *Machine Tool Blue Book,* v. 42, July '46, p. 175-176, 178, 180, 182, 184, 186.

Area of contact between wheel and work; type and condition of grinding machine; ratio of work speed to wheel speed.

20-345. **Maximum Clamping at Minimum Cost.** Fred R. Swanson. *American Machinist,* v. 90, Aug. 1, '46, p. 93-96.

Hydraulic clamping meets a need where multiple clamps, preset pressures and ready locating are required on irregular work.

20-346. **Stop Machine Tool Chatter.** George Holman. *American Machinist,* v. 90, Aug. 1, '46, p. 100-101.

Common factors to be considered in connection with machine tool chatter.

20-347. **Practical Ideas.** *American Machinist,* v. 90, Aug. 1, '46, p. 131-136.

Precision dividing can be done on a standard engine lathe. Micrometer bracket aids taper checking. Collet stop positions work longitudinally. Soldering iron heat mushrooms belt pins. An oldtimer shows them how to repair a large valve seat. Edge-locating gage aids jig boring work. Prevent drilling accidents by double-set-screwing taper shanks. An efficient way to cut coarse threads. Adjustable spring dog speeds lathe grinding. Flat spring makes ejector for piercing punch. Diemaker's

square has inspection peep hole. Floating spindle fixture regrinds end mills. Taper-reamer cuts radius-formed toolbits. Boring bar cuts inaccessible oblique holes in angle iron. Wire brush clears loaded grinding wheels.

20-348. **Principles of Metal Cutting. Part 2.** M. Eugene Merchant. *Die Casting,* v. 4, Aug. '46, p. 59-60, 62, 64, 66.

Power consumed in the removal of metal; finish produced on the work; life of the cutting tool between resharpenings.

20-349. **Jigs and Fixtures.** *Automobile Engineer,* v. 36, July '46, p. 297-303.

"Wharton" universal system of construction from basic units. System appears to have far-reaching possibilities in prototype, batch and large-scale production. Descriptions given of major units that go to make system suitable for a wide range of machining operations, and also of actual applications.

20-350. **Carbide Milling Cutters.** *Automobile Engineer,* v. 36, July '46, p. 309-310.

Tests show that a cutter with solid carbide blades wedged into the body at 15° positive radial rake angle and given a negative face of small width at the cutting edge gives the following results in comparison with a cutter having negative radial and axial rake angles: Substantially more pieces are machined between regrinds; cemented carbide material is used more economically; vibration and deflection of the workpiece are decreased; less power consumed; an acceptable standard of finish without any objectionable burr was always produced.

20-351. **Magnetic Chucking.** *Steel,* v. 119, Aug. 12, '46, p. 78-79.

Alternate laminations of nonmagnetic steels form a holding surface that can be used to its extreme edges.

20-352. **Instruments Often Help Machines Work at Peak Efficiency.** John H. Miller. *Product Engineering,* v. 17, Aug. '46, p. 118-121.

Typical functional uses of instruments on grinders, die sinkers, and automatic screw machines for maximum loading or optimum operation. Simplified method of metering a variety of motors that differ in horsepower, voltage, or phase by using a single standard meter matched to the load by an adjustable doughnut transformer.

20-353. **Simplified Variable-Voltage Drive Is Key to Improved Mechanical Design.** W. E. Happel and G. A. Caldwell. *Product Engineering,* v. 17, Aug. '46, p. 127-129.

How development of a simplified constant-torque speed control system proved to be the key to obtaining many mechanical improvements. Step-by-step discussion of problems in redesigning typical headstock and their solutions. Series variable-voltage drive explained and its operating characteristics and limitations discussed.

20-354. **Tool Kits Cut Costs.** Mitchell Mastalerz. *American Machinist,* v. 90, Aug. 15, '46, p. 129-131.

Van Norman tool control gives faster and better service

by issuing tool sets, controlling them by a flexible system and scheduling them to operations.

20-355. **Practical Ideas.** *American Machinist,* v. 90, Aug. 15, '46, p. 135-140.

Air pressure "inspector" simulates working load. Adjustable micrometer is easy to make. Quick lathe setup cuts short wire lengths. Combination fixture stacks and rivets magnetic laminations. U-bracket prevents slew in single screw shaper tool-post. Boring large holes in bakelite with a small Van Norman miller. Adjustable-wedge toolholder for high-load carbide turning. Leveling screws adjust toolmaker's clamp precisely. Chip remover operates with vacuum air blast. Plastic stop-off simplifies quantity chromium plating. Height gage sets lathe tools.

20-356. **Advancing the Art of Milling.** H. A. Frommelt. *Machine Tool Blue Book,* v. 42, Aug. '46, p. 261-268.

Kennamilling is a combination of carbide and a technique built around a cutter design that makes possible radically new and different blade grinding and blade setting methods.

20-357. **Gisholt Two-Element Unbalance Measuring and Correcting Equipment.** *Machine Tool Blue Book,* v. 42, Aug. '46, p. 286, 288-292.

Complete, semi-automatic equipment for measuring and correcting unbalance in automotive type crankshafts. Equipment consists of two electrically connected machines. In each of the examples given, corrections for balance may be made in each of the planes through 360° of arc.

20-358. **Automatic and Indexing Fixtures.** B. P. Graves. *Tool Engineer,* v. 17, Aug. '46, p. 36-40.

Ultramodern tools and methods essential to manufacturing economy. Electrically operated fixtures for milling machines; air-operated head raising equipment; grinding to master former; automatic indexing turret mechanism.

20-359. **Friction Sawing Facts and Figures.** H. J. Chamberland. *Western Machinery and Steel World,* v. 37, Aug. '46, p. 106-108, 135.

Limitations and advantages.

20-360. **Tool Life and the Selection of Carbide. (Continued.)** Raymond O. Catland. *Western Machinery and Steel World,* v. 37, Aug. '46, p. 116-120.

Tool life comparison of S.A.E. 4130 and N.E. 8630 steels; tool life comparison of N.E. 8630 and S.A.E. 1020 steels; tool life results applied to practice.

20-361. **Broaching Cuts Machine Time for Cylinder Block Processing.** John T. Smith. *Production Engineering & Management,* v. 18, Aug. '46, p. 51-54.

Average depth of 5/32 in. of metal for the full width of an engine block is removed in a single pass at the rate of 33 ft. per min. by application of slab surface broaching.

20-362. **Hopper Fed Magazine Attachment on the Automatic Screw Machine.** W. E. Mueskes. *Screw Machine Engineering,* v. 7, Aug. '46, p. 40-42.

With use of attachments, secondary operation work can

be most successfully and economically produced. Following advantages in producing parts from bar stock are attainable: completely automatic cycle; sustained accuracy; fast production time; operator can operate other machines.

20-363. **Secondary Operation Work on a Multiple Spindle Automatic by the Use of Magazine Attachments.** *Screw Machine Engineering,* v. 7, Aug. '46, p. 50-53.

Illustrates a few of the many methods of applying various types of magazine attachments to a multiple spindle automatic and the advantages of each type.

20-364. **Bardons and Oliver No. 2 Geared Electric Turret Lathe.** *Screw Machine Engineering,* v. 7, Aug. '46, p. 59-62.

Single lever used for start, stop and reversing of spindle; high-low spindle speed control lever; range of turret feeds; automatic reversal or change in spindle speed; cross slide; spindle speed control; choice of methods of feeding bar stock.

20-365. **Producing the Fordson Plough.** *Machinery (London),* v. 69, July 25, '46, p. 97-102.

Machining of typical steel castings.

20-366. **Securing Diamonds in Wheel-Dressing Tools.** H. L. Strauss. *Machinery (London),* v. 69, July 25, '46, p. 103.

Four principal methods by which the diamonds are secured in tools for wheel-dressing purposes: brazing; casting; powder metallurgy; and induction heating. Advantages and disadvantages.

20-367. **Does the Drill Point Clear?** W. E. Ainsworth. *American Machinist,* v. 90, Aug. 29, '46, p. 120-121.

Drill-point clearance can be measured accurately. Shows method devised to replace inaccurate protractor measurement.

20-368. **Practical Ideas.** *American Machinist,* v. 90, August 29, '46, p. 123-128.

Long-extension adjustable toggle moves heavy slabs smoothly. Opposed dowel locates reverse side of hole. Guided center-punch has crossed knife-edges. Jig centers and holds round stock for bushing drilling. Hints on small tools. Justice for the lowly screwdriver. Emergency hacksaw proves valuable tool. Solid die and stripper solves punch breakage. Telescoping centers hold armature for bearing pressing. Eccentric rod adjusts chamfering tool.

20-369. **Selecting a Machine Tool for Carbide Tooling.** T. C. DuMond. *Materials & Methods,* v. 24, Aug. '46, p. 374-378.

Lists and discusses qualifications which make a given machine tool well suited for carbides.

20-370. **A Comparison of the Various Grades of Cemented Carbide Tool Materials.** *Materials & Methods,* v. 24, Aug. '46, p. 419.

Standard grades of cemented carbide tool materials made by seven leading manufacturers are compared. Appropriate grades of carbide tool materials are given for each of the common machining operations according to the type of material to be machined.

20-371. **Friction Band-Sawing of Hard Materials.** C. H. Wick. *Machinery (London),* v. 69, Aug. 8, '46, p. 161-164.

While ordinary saw cuts chips, the dry-friction saw blade develops enough frictional heat in the cut to soften the material, and the teeth of the blade carry this softened material out of the cut. Miscellaneous applications.

20-372. **Operations on the Fordson Plough. (Continued.)** *Machinery (London),* v. 69, Aug. 8, '46, p. 165-168.

Further machining and assembly operations.

20-373. **Optical Centering.** S. C. Poulsen. *Aircraft Production,* v. 8, Aug. '46, p. 359-361.

Use of low-power microscope for accurate alignment of hole centers on photo-lofted work surfaces. Device allowed holes to be drilled at the rate of 2, or at the most, 3 min. per hole, where previously a time of 15 min. per hole was required. Results were consistent, errors rarely exceeding 0.003 in.

20-374. **Machining Engine Valves. Part II.** *Aircraft Production,* v. 8, Aug. '46, p. 372-376.

Tooling of the five-spindle automatics for the remainder of the exhaust-valve operations and for the simpler inlet-valve sequences.

20-375. **Radial Drills Are Versatile.** John E. Hyler. *Modern Machine Shop,* v. 19, Sept. '46, p. 138-140, 142, 144, 146, 148, 150, 152, 154, 156.

When large or heavy work presents a drilling problem, the answer can be found in one of the many types and designs of radial drilling machines.

20-376. **Production Experience Proves Economy of Crush Grinding.** C. J. Linxweiler and R. Y. Moss. *Iron Age,* v. 158, Aug. 29, '46, p. 34-38.

Process is described and actual case histories are given to show the economies that can be effected over conventional grinding methods.

20-377. **The Retention of Ball Races by Spinning.** C. Monday. *Machinery (London),* v. 69, Aug. 15, '46, p. 207-208.

Against advantages of lightness and simplicity must be set disadvantages of a chance of less accurate positioning and the difficulty of effecting replacements in the event of damage or wear. Typical example in which the conditions are favorable for this type of fitting is given.

20-378. **Now—Jigs and Fixtures From "Building Blocks".** *American Machinist,* v. 90, Sept. 12, '46, p. 125-126.

Describes and illustrates elements used for built-up jigs and fixtures. When assembled, various locations are said to be reliable without resort to extensive gaging. Strength of the structure is said to be sufficient to resist cutting pressures when cemented carbide cutting tools are used. Method is known as the Wharton system and was developed in England.

20-379. **Practical Ideas.** *American Machinist,* v. 90, Sept. 12, '46, p. 139-144.

Attachment for plate roll makes heavy U-bends. Hex-socket capscrews make good nut positioners. Triple-yoke

equalizing clamp to castellate four hex nuts. Graduated handwheel shows carriage travel. Emergency laboratory pump has many uses. Multiple clamps operate from punch press ram. Hints on small tools. Slot drill jig is ideal for short-run production. Portable pneumatic machine faces blind flanges. Peculiar curved-surface intersections scribed easily.

20-380. **Saving Material With Contour Saws.** H. J. Chamberland. *Machine Tool Blue Book,* v. 42, Sept. '46, p. 177-180, 182-183.

How contour saws may be used to advantage on wide range of jobs with a worth-while saving of time and material.

20-381. **Carbide Tool Misconceptions.** Harry Crump. *Machine Tool Blue Book,* v. 42, Sept. '46, p. 185-187.

Enumerates six common misconceptions and debunks them.

20-382. **Widening Useful Boring Range.** H. E. York. *Machine Tool Blue Book,* v. 42, Sept. '46, p. 231-232, 234.

In recent tests, a number of boring bars were made up out of solid Carboloy cemented carbide to determine extent to which advantage can be taken of the metal's stiffness in this type of application. Carboloy grade 55-A was used for the boring bars. Tips were of Carboloy Grade 999 and were brazed to the bars with Easy-Flo.

20-383. **Pneumatic Tools Help to Speed Industry.** *Machine Tool Blue Book,* v. 42, Sept. '46, p. 249-252, 254, 256-258, 260.

Some of the more common jobs illustrated and described.

20-384. **Grinding Operations on Stellite and Hastelloy Products.** *Machinery,* v. 53, Sept. '46, p. 148-149.

Pictures with brief explanations of various operations.

20-385. **Broaching in Postwar Production.** O. W. Bonnafe. *Machinery,* v. 53, Sept. '46, p. 155-157.

Advantages of broaching. Typical example of the effectiveness of broaching is its adaptation to the production of close-grained cast iron, electric flatiron soleplates having a Brinell hardness of from 230 to 250. Two-thirds of former machining cost is saved. Also describes use of broaching in production of cast iron frames for weaving looms.

20-386. **Modern Flat Surface Grinding Practice.** J. C. Arndt and W. S. Hallowell. *Machinery,* v. 53, Sept. '46, p. 158-165.

Disk grinding.

20-387. **Machining Compressor Crankshafts.** G. Eldridge Stedman. *Steel,* v. 119, Sept. 16, '46, p. 94, 118.

Special machining setups used in Servel plant to finish crankshafts accurately to tolerances and quantities required.

20-388. **Jig and Fixture V-Blocks.** A. H. Stanton. *Tool & Die Journal,* v. 12, Sept. '46, p. 84-86.

Selection and development of standards covering interchangeable precision V-blocks for jig and fixture applications.

20-389. **Your Shaper Makes a Fine Marking Machine.** H. O. Bates. *Tool & Die Journal,* v. 12, Sept. '46, p. 105-108.

Required is a simple holding fixture for securing the marking die to the business end of the shaper ram, and a supporting surface, vise or clamp, to hold the work while marking.

20-390. **Turret Lathe Machining of Multiple Diameters on Shafts.** R. H. Stebbins. *Screw Machine Engineering,* v. 7, Sept. '46, p. 37-42.

By engineering a job so that the cross slide operations overlap with those of the turret, or vice versa, it is possible to reduce greatly the total machining time per part. Principle is illustrated in actual production record where a Gisholt Model 2L saddle-type turret lathe is used to machine 12 surfaces of a shaft using standard tools and holders exclusively throughout the complete tooling setup.

20-391. **Helpful Points in the Design of Slotting Bushings.** *Screw Machine Engineering,* v. 7, Sept. '46, p. 57-59.

Seven blueprint diagrams illustrate how to set up for slotting on an automatic screw machine.

20-392. **Machinability of Two N.E. Steels.** Robert C. Gibbons. *Steel,* v. 119, Sept. 23, '46, p. 106, 174-175.

Cutting and threading difficulties with 8600 series found to be more closely related to microstructure than hardness. Best results are obtained with fine lamellar structure resulting from proper annealing.

20-393. **Combination Grinding Wheel Dresser.** J. Robert Moore. *Machine Design,* v. 18, Sept. '46, p. 101-105.

Features pantograph for guiding diamond, also self-driven crush-former.

20-394. **Electronic Motor Control.** Mark Morgan. *Machine Design,* v. 18, Sept. '46, p. 114-119.

Provides unusually simple and flexible feed drive for new vertical milling machine.

20-395. **Tooling for Low-Cost Output on Short Runs.** Wallace A. Scotten. *Product Engineering & Management,* v. 18, Sept. '46, p. 51-55.

Multiple-spindle drilling setup cuts production time, eliminates single-spindle machines; combine standard heads in drilling setup to slash time on heavy truck axles; better lathe tooling eliminates three operations and increases output 100%.

20-396. **Cost-Cutting Tools and Methods for Volume Precision Work.** *Production Engineering & Management,* v. 18, Sept. '46, p. 66-74.

Up-to-date, power-packed, cost-cutting tooling at Studebaker's South Bend plant is setting new production standards for boring, casting, drilling, fixtures, grinding, heat treat, honing, and special machines.

20-397. **Greater Efficiency From Improved Machine Tools.** *Production Engineering & Management,* v. 18, Sept. '46, p. 76-77.

New drilling machine cuts process time and reduces la-

bor burden. Precision broaching with a machine that automatically loads and unloads on long-run production work.

20-398. **Hydraulic Spacer Replaces Drill Jigs.** *Iron Age,* v. 158, Sept. 26, '46, p. 73.

Pinpoint precision of the drilling of holes in metal parts without the use of jigs and at a saving in time of 20% or better is reported. Unit consists of a heavy flat table, which moves either laterally or longitudinally on its base under an accurate drill spindle fixed rigidly in one position. With the work clamped in place, the table is hydraulically traversed from one predetermined position to another by means of two selector controls, one for lateral positions, the other for locating longitudinal positions.

20-399. **Exploring Carbide Possibilities in Single-Point Turning.** J. F. Allen. *Tool Engineer,* v. 17, Sept. '46, p. 27-35.

Refers to a program of metal cutting research being conducted in a special laboratory at the Warner & Swasey Co. Describes equipment set up for this work, and some of the methods involved. Briefly discusses the complexity of the metal cutting problem and some of the test results and findings.

20-400. **Mechanical Variable Speed Transmissions.** Lev. A. Trofimov. *Tool Engineer,* v. 17, Sept. '46, p. 36-40.

Infinitely variable transmissions synchronize machine cycles and provide correct speeds and feeds.

20-401. **Machining Stainless Steels. Part 1.** E. Von Hambach. *Steel,* v. 119, Sept. 30, '46, p. 62-65.

Recommended procedures for drilling, tapping, and reaming.

20-402. **New Milling Machines.** *Western Machinery and Steel World,* v. 37, Sept. '46, p. 114-115.

New medium-sized knee-and-column type milling machine, incorporating many unique and noteworthy features. Designated No. 2MI, machine is powered by a 5-hp. motor, and is built in plain, universal and vertical styles.

20-403. **Tool Life and the Selection of Carbide. (Continued.)** Raymond O. Catland. *Western Machinery and Steel World,* v. 37, Sept. '46, p. 124-126, 137.

Types of wear on the tool when milling cast iron; shape of tool used in tool life experiments; materials tested; speed selection; surface finish; carbide selection for milling cast iron; rake angle selection.

20-404. **"Flow Production" Speeds Metal Work at Ryan.** W. P. Brotherton. *Western Metals,* v. 4, Sept. '46, p. 15-18.

How production of metal work is organized at Ryan Aeronautical Co. for maximum efficiency.

20-405. **Surface Preparation Procedures.** *Die Castings,* v. 4, Oct. '46, p. 60, 62, 64-65.

Grinding, buffing, deburring, polishing or honing of small die castings is accomplished by the Roto-Finish process at the King-Seeley Corp. where one man can deburr an average of 12,000 pieces in 5 hr.

20-406. **"Immersion" Milling of Oleo Cylinder Forks.** *Machinery (London),* v. 69, Aug. 22, '46, p. 225-228.

Cutting time reduced to between 5 and 6 min. Despite small diameter of cutters in relation to amount of metal to be removed, it has been found possible to mill as many as 45 components without regrinding, involving the production of more than 4 cwt. of swarf.

20-407. **Elimination of Vibration in Machine Tools.** *Machinery (London),* v. 69, Aug. 22, '46, p. 241-242.

Some of the major elements of mechanical vibration. Electrical network analogy.

20-408. **Practical Ideas.** *American Machinist,* v. 90, Oct. 10, '46, p. 139-144.

Roller follow-rests permit heavy cuts in slender shaft turning. Reinforcement prevents breakage at pipe-tank connections. Sensitive "jack" supports thin rods for splining. Triangular button gage checks many angles. Paper strip calibrates micrometer dials. Relocating plate shortens setup time. Hints on small tools. Bayonet joint for drill tap and reamer extensions. Rapid return mechanism speeds thread cutting. False center for laying out castings. Boring bar holder takes two sizes.

20-409. **Air-Operated Clamping Aids to Production.** *Machinery (London),* v. 69, Aug. 29, '46, p. 257-261.

Applications in machine and press shop practice.

20-410. **Hollow Drilling Armor Plate by Negative-Rake Cutters.** *Machinery (London),* v. 69, Aug. 29, '46, p. 263-266.

Two operations in which carbide-tipped and high speed steel cutters ground to negative-rake angles are used in armor.

20-411. **Preparation of Zinc Alloy Die Castings for Plating.** H. K. Barton and L. C. Barton. *Machinery (London),* v. 69, Aug. 29. '46, p. 276-279.

Machining and abrasive techniques used; diagrams of equipment.

20-412. **Machining Connecting Rods for Small Internal-Combustion Engines.** L. Maguire. *Machinery (London),* v. 69, Sept. 5, '46, p. 299-301.

Typical method adopted on Douglas engines. Connecting rods are high-grade nickel-chromium casehardening steel forgings.

20-413. **Air-Operated Clamping Aids.** *Machinery (London),* v. 69, Sept. 5, '46, p. 302-305.

Pollard cam-operated machine is made fully automatic by the provision of an air-operated fixture which feeds, clamps, and ejects the workpieces as required. Mechanism of the fixture for cam-operated drilling machine; air-operated hoist.

20-414. **Machining of Plain Bearings With Single-Point Tools. Part II. Bearing Theory.** P. Grodzinski. *Petroleum,* v. 9, Sept. '46, p. 214.

Diamond vs. tungsten carbide tools and selection of diamond tools.

20-415. **Machining Stainless Steels. Part 2.** E. Von Hambach. *Steel,* v. 119, Oct. 7, '46, p. 116-118, 150, 152, 154, 156, 158.

Requirements for satisfactory economical results in turning, threading and milling these steels.

20-416. **Grinding Precision Tools.** H. J. Chamberland. *Steel,* v. 119, Oct. 7, '46, p. 126, 129.

Factors which contribute to micro-inch accuracy in grinding gage blocks and other precision tools, upon which modern mass production depends, are re-examined.

20-417. **Thread Profile Turning and Boring.** E. F. S. Crowe. *Machinery (London),* v. 69, Sept. 12, '46, p. 338-339.

Tool described was in operation for a period of about 12 months, completing the full contract for the component it was designed to produce and showing a saving of about 50% on the original time for screw cutting.

20-418. **Labor-Saving by the Use of Pneumatic Work Fixtures.** Charles H. Wick. *Machinery,* v. 53, Oct. '46, p. 137-145.

Use of diaphragm-type air chambers for such operations is relatively new. Operation of jigs, fixtures, chucks, and other work-holding devices results in labor economy, increased production, safety, compactness and reduced maintenance. Basic parts required for operation and control of the fixtures.

20-419. **Grinding Dovetail Serrations on Aircraft Turbine Buckets.** G. V. Keller. *Machinery,* v. 53, Oct. '46, p. 147-152.

New design of crusher-roll holding fixture which replaces ball bearings with roller bearings, and includes facilities for adjusting the amount of end play. Discusses grinding operations; crushing the grinding wheel; crusher rolls.

20-420. **Work-Holding Methods Used in Surface Grinding.** J. C. Arndt and W. S. Hallowell. *Machinery,* v. 53, Oct. '46, p. 160-166.

Examples of methods and devices used in connection with the grinding of flat surfaces on surface grinding machines.

20-421. **Carbide Tooling at the New York Naval Shipyard.** C. A. Palmer and J. G. Kenney. *Mechanical Engineering,* v. 68, Oct. '46, p. 879-884.

Development of the program; brief description of machine shops and examples of specialized carbide applications.

20-422. **Crush-Dressing of Grinding Wheels.** Richard Y. Moss. *Mechanical Engineering,* v. 68, Oct. '46, p. 885-888.

Consensus of many users of the method as to best current practice; certain test information which supports the prospect that wider industrial applications in many fields may logically be expected.

20-423. **Roll Turning.** *Iron and Steel,* v. 19, Sept. '46, p. 506.

Lathe illustrated has centers 14½ in. high and will admit rolls up to 24 in. maximum diameter over the body by 8 ft. long over-all. It is provided with two front saddles having continuous feeds for roughing, and one pianoboard rest and one necking rest at the rear for finishing.

20-424. **Automatic Broaching Speeds Auto Parts Output.** *Iron Age,* v. 158, Oct. 10, '46, p. 66.

Broaching the bore of automotive hypoid bevel drive gears at the rate of 225 per hr., with a stock removal of 0.020 in.

20-425. **Check Chart for Turning Stainless Steels.** *American Machinist,* v. 90, Oct. 10, '46, p. 145.

Table shows the high and low range of speeds and feeds for turning stainless steels, in hot rolled, cold drawn and centerless ground condition, and in hardness ranging from Brinell 187 to 250.

20-426. **Check Chart for Tapping Stainless Steels.** *American Machinist,* v. 90, Oct. 10, '46, p. 147.

Spiral-flute or spiral-pointed straight-flute taps are desirable, especially for the softer and non free machining types of alloys. In tapping stainless, particularly fine pitches, select drill sizes with care. Check each job with the formula given.

20-427. **Tooling the Automatic Screw Machine, XVII.** Noel Brindle. *Modern Machine Shop,* v. 19, Oct. '46, p. 124-132, 134.

Second operations on screw machines; methods, tools, and the use of magazine attachments.

20-428. **Research on Industrial Diamonds.** John T. Roberts. *Modern Machine Shop,* v. 19, Oct. '46, p. 138-140, 142, 144, 146, 148, 150, 152, 154.

Tabulation of the results of a study made by the Crane Co. during the war on the various types of industrial diamonds used for wheel dressing.

20-429. **A New Method of Gear Grinding.** T. J. Putz and H. W. Semar. *Modern Machine Shop,* v. 19, Oct. '46, p. 184, 186, 188.

Short description of methods employed in the Westinghouse South Philadelphia plant for grinding large gears for turbine locomotives.

20-430. **Automatic Machining of Automotive Valves.** *Steel,* v. 119, Oct. 14, '46, p. 116, 118.

Machining of valves performed on automatic machine at rate of 400 to 500 per hr.; lone operator function is to load machine.

20-431. **Machine Tool Contour Controller.** J. M. Morgan. *Electronics,* v. 19, Oct. '46, p. 92-96.

Automatic contouring controls simplify machining such odd-shaped work as cams or dies that cannot be machined on a standard machine without excessive labor. The one described accomplishes its purpose by following and duplicating contours of a master templet or pattern. It gives positioning follow-up that is completely electrical, highly accurate, continuous instead of step by step, drives the tool at constant travel speed, and is flexible in its control of the machine.

20-432. **Metal Shearing Operations.** John E. Hyler. *Tool Engineer,* v. 17, Oct. '46, p. 27-29.

Tools and techniques for shearing plate, shapes, bars, and sheet metal.

20-433. **Crush Form Thread Grinding—British Method.** L. H. Rhodes. *Tool Engineer,* v. 17, Oct. '46, p. 39-45.

Outline of crush forming of grinding wheels and current practices in England.

20-434. **Electrical Circuits for Automatic Tools. Part III.** P. H. Winter. *Tool Engineer,* v. 17, Oct. '46, p. 46-48.

Application in specific installations. Step-by-step development of each installation.

20-435. **Boring and Facing Head Speeds Production.** Fred W. Steiner. *Tool Engineer,* v. 17, Oct. '46, p. 54.

New Giddings & Lewis attachments increase range and versatility of horizontal boring machines.

20-436. **Carbides Require More Powerful Machines.** Eugen Hirschfeld. *American Machinist,* v. 90, Sept. 26, '46, p. 108-112.

Cemented carbides can be used effectively on single-purpose machines with powerful motors and rigid toolholders. Other machines will be redesigned to take advantage of carbide tools.

20-437. **Transfer-Table "Millpress" Bores Car Wheels Ten Times Faster.** *American Machinist,* v. 90, Sept. 26, '46, p. 124-125.

Automatic cycle machine finishes wheel in a single pass. Carbide tools and rigid construction help speed, transfer table cuts loading.

20-438. **Practical Ideas.** *American Machinist,* v. 90, Sept. 26, '46, p. 139-144.

Standard height gage adapter eliminates blocks in sine bar work. Removing blind bushings by hydraulics. Follower rest permits heavy single-cut taper turning. Taper reamer bores porcelain enamel without chipping. Scale attachment for hex boring bar gages depth. Counterbore in portable drill trims tube ends. Microscope gages small dimensions during grinding. Double-pressure pressing assures good fits. Trunnion die shoe holder saves setup time. Cut Woodruff key seats in your lathe. Belted blower removes grinding dust. Solder pot.

20-439. **Milling Cutter Data.** *American Machinist,* v. 90, Sept. 26, '46, p. 145.

Table gives circular clearance drop on cutters and reamers. Clearance drop is a convenient means of determining whether cutters are ground with the correct clearance angle, because the drop is easily measured with a dial indicator.

20-440. **Machining Aluminum With Carbide Tools.** Caroll Edgar. *Light Metal Age,* v. 4, Sept. '46, p. 8-10.

General machine considerations; feeds and speeds; coolants; chip control and disposal.

20-441. **Revacycle Gear Cutting and Tire Press Two Innovations at the Fort Wayne Plant.** Joseph Geschelin. *Automotive and Aviation Industries,* v. 95, Sept. 15, '46, p. 41, 84, 86.

New differential bevel gear production method is responsible for greatly increased productivity and lower prime cost. Former Gleason generators produced the differential side gear in two minutes, at rate of 30 pieces per

hour: Revacycle takes only 0.895 min. per piece or a rate of 67 pieces, plus, per hour. Also describes mechanical handling setup for wheel and tire assemblage and tire inflation, which results in greater speed, complete safety and considerably less manual effort.

20-442. **Taper Form Grinding of Piston Skirts.** *Iron Age,* v. 158, Oct. 17, '46, p. 56-57.

Scrivener patented piston-grinding machine shown provides, it is claimed, the only method of generating a taper from an irregular outline to a true circle, and therefore is capable of producing a piston form which will comply with the theoretical considerations outlined.

20-443. **Lathe Converter.** *Steel,* v. 119, Oct. 21, '46, p. 112.

Universal milling and grinding unit complete with interchangeable heads performs series of different machining operations with only one setup.

20-444. **Machining and Finishing Cylinder Bores at Buick.** Kenneth Rose. *Materials & Methods,* v. 24, Sept. '46, p. 619-621.

Method provides for use of machining operations that create a minutely grooved surface, a honing or lapping process to smooth this surface partially, and a chemical treatment to create a surface texture that will promote proper lubrication during the early life of the car. Several interesting tools and inspection devices have been developed for the process.

20-445. **Power Hacksaw Ills—Their Causes and Cures.** William Shortell. *Iron Age,* v. 158, Oct. 24, '46, p. 56-57.

Reasons for the frequent breakage, excessive wear, and crooked cutting of power hacksaw blades; suggested remedies. A new instrument for maintaining constant tension on the blade during the entire cutting operation is also described as well as a second instrument for gaging the cutting pressure.

20-446. **Internal Grinding Practice. Part I—General Considerations.** John E. Hyler. *Machine Tool Blue Book,* v. 42, Oct. '46, p. 197-198, 200, 202, 204, 206, 208, 210, 212, 214.

Hole finish-ground to size may be through or blind, cylindrical or tapered, formed in different ways, interrupted, or different combinations of these. Different types of internal grinding machines are used, depending on the type of work, amount of work and other factors.

20-447. **Boosting Gear Output.** *Machine Tool Blue Book,* v. 42, Oct. '46, p. 235-236.

Use of underpass curve-shaver ups output of gears 36 to 110 per hr. Chart shows that the accuracy of the involute can be held to close limits despite high output of the machine. Spacing errors are less than 0.0003 in.; eccentricity is below 0.0015 in.

20-448. **Lapping Radius-Formed Pivot Bearings.** *Machinery (London),* v. 69, Sept. 26, '46, p. 395-396.

Machine for simultaneously and automatically lapping the two radius-formed supporting pivots of a wheel-spindle is designed to duplicate motions previously employed in hand-lapping radius-formed pivots and to

eliminate inaccuracies which could not be avoided when the hand-lapping method was used. Provides proper support for work and produces motions necessary for accurately lapping the two pivots to a high surface finish in minimum operating time, without destroying original form of the radius-ground pivots.

20-449. **British Machine Tools During the War.** A. H. Lloyd. *Institution of Mechanical Engineers Proceedings,* v. 154, Sept. '46, p. 216-219.

New developments described and illustrated by photographs of new equipment and diagrams.

20-450. **Efficient Manufacture of Complex Power Units.** *Production Engineering & Management,* v. 18, Oct. '46, p. 66-74.

Better use of productive machine time and ingenious setups that reduce downtime has placed the manufacture of custom-built engines on a competitive basis with mass produced units at Cooper-Bessemer.

20-451. **Machining Inco Nickel Alloys.** *Production Engineering & Management,* v. 18, Oct. '46, p. 83.

Recommended shank size for carbide insert tools.

20-452. **Improve Work Finish and Accuracy by Using Shaving Tools.** *Screw Machine Engineering,* v. 7, Oct. '46, p. 45-47.

Application of shaving tools to both single and multiple spindle automatic screw machines and the design principles which should be followed.

20-453. **Alcoa Aluminum in the Automatic Screw Machine.** *Screw Machine Engineering,* v. 7, Oct. '46, p. 48-53.

Problems pertaining to the machining of aluminum. (This and subsequent installments are taken from a booklet entitled "Alcoa Aluminum in the Automatic Screw Machine" to be published by Aluminum Co. of America. The following parts will not be reviewed.)

20-454. **Turret Slotting in the Automatic Screw Machine.** *Screw Machine Engineering,* v. 7, Oct. '46, p. 55-58.

Using a single setup to complete a part entirely is illustrated. Combines into one operation the usual distinct operations of screw machine blank, slotting in a milling machine and spreading in a kick press.

20-455. **Precision Sheet-Metal Work. Part II.** *Aircraft Production,* v. 8, Oct. '46, p. 465-476.

Turbine nozzle-ring assemblies and the exhaust units. Some of the operations on the machined parts of the assemblies are also briefly described.

20-456. **Profile Copying.** *Aircraft Production,* v. 8, Oct. '46, p. 482-483.

Messerschmitt machine with optical control for contour milling direct from templet layouts.

20-457. **How to Select Carbide Milling Cutters.** D. V. Stevens and A. O. Schmidt. *American Machinist,* v. 90, Oct. 24, '46, p. 112-116.

Carbide face-milling cutters which are giving high rates of metal removal, reducing power consumption and ex-

tending cutter life. Cutters have solid carbide blades, double radial-rake angles, radial blade location, wedges behind the blades and forged steel bodies. Both ferrous and nonferrous metals can be milled at high metal removal rates. Primary radial-rake angles may be varied from 0 to 10° positive for cast iron and nonferrous metals and from 6 to 10° negative for steel.

20-458. **Surface Plates for Precision.** A. M. Grasse. *American Machinist,* v. 90, Oct. 24, '46, p. 125-127.

Large surface plates, properly installed, save machining time where quantities do not justify the cost of jigs and fixtures. Includes suggestions for their proper care.

20-459. **Practical Ideas.** *American Machinist,* v. 90, Oct. 24, '46, p. 131-136.

Precision angle checking without special equipment. Tap and die holder speeds short lathe threading jobs. Flexible conduit with stiffener makes coolant nozzles. Double-edged countersink works both ways. Clamp holds bar stock on bandsaw cutoff attachment. Hints on small tools. Understand the lathe threading dial to get its full advantage. Adjustable inside micrometer fits around boring bar.

20-460. **Production Processes. Part XVI—Abrasive Belt Machining.** Roger W. Bolz. *Machine Design,* v. 18, Oct. '46, p. 93-96.

Wet belt method; surface finish excellent; stock removal limits area; design; materials finished either on wet or dry belt machine; tolerances.

20-461. **Developments in Modern Tooling.** *Railway Mechanical Engineer,* v. 120, Oct. '46, p. 532-533.

Report presented at Locomotive Maintenance Officers' Association meeting discusses use of carbides and hydraulic controls on machine tools to reduce machining time.

20-462. **Ideas From Readers.** *Modern Machine Shop,* v. 19, Oct. '46, p. 200, 205-206, 208, 210, 212, 214.

Torch-annealing on the job. Dowel pin puller. Speeding up a power press. Sheet metal crimping tool. Checking length and skew.

20-463. **Preparing and Reconditioning Diamond Charged Cast-Iron Wheels.** P. Grodzinski. *Industrial Diamond Review,* v. 6, Oct. '46, p. 295-299.

Use of cast-iron laps with loose diamond dust not only in the diamond industry but also in related industries such as gage making, sharpening sintered carbide tools, etc.

20-464. **Use of Cutting Fluids in Machining Light Alloys.** James L. Erickson. *Light Metal Age,* v. 4, Oct. '46, p. 8-12.

Not only is a cutting fluid an essential factor in the machining of certain light metal alloys, but also the use of a proper cutting fluid will even improve the efficiency of machining those light metal alloys which today are machined dry by many shops.

20-465. **Air-Power Control of Machine and Work Feeds.** *Tool & Die Journal,* v. 12, Oct. '46, p. 87-89.

Flexibility of application of the Bellows Air-Motor is attributable to its design, wherein unique control features are incorporated in head of the motor. Describes some applications.

20-466. **Accuracy of Diamond Dressing Combined With Economies of Crusher Roll Form Grinding.** *Tool & Die Journal,* v. 12, Oct. '46, p. 104-106, 170.

Moore Panto-Crush grinding wheel dresser employs precision pantograph control to initially impart the specified form to the grinding wheel. The diamond dressed wheel is then used to grind the work form into the crusher which, in turn, is capable of many subsequent touch-up dressings of the wheel in the course of grinding workpiece to the finished form from the solid.

20-467. **How to Select the Correct Grinding Wheel.** R. B. Fair. *Iron Age,* v. 158, Oct. 31, '46, p. 41-45.

Outlines simple, practical methods of selecting the correct wheel for a given job and points out some of the more common fallacies which often lead to cheap wheel costs, but excessive cost per pound of metal removed.

20-468. **Electronics and Precision Grinding Machines.** *Engineer,* v. 182, Oct. 4, '46, p. 300.

Use of electronic control on several types of grinding machines as practiced in England.

20-469. **Electrolytic Cutting of Metal.** K. Y. Skorniakov. *Engineers' Digest,* v. 3, Oct. '46, p. 498.

A new way of cutting metal by a combination of electrical and mechanical action has been introduced at the Stalin works in Gorki. It takes the place of circular saw work and is particularly suitable for heat treated steels, hard alloys and thin tubes, but is also useful for ordinary sections. A rotating disk is pressed against the work and the electric current passes from the work through an electrolyte to the disk, rapidly removing the metal by electrodynamic and electrochemical action. (From *Promishlennaya Energetika,* no. 1, Jan. '46, p. 11.)

20-470. **Precision Grinding.** Robert S. Burpo, Jr. *Materials & Methods,* v. 24, Oct. '46, p. 921-936.

Range of uses for the principal types of precision grinding machines. Case studies are given to illustrate their capabilities.

20-471. **Some Characteristics of Standard Plain Grinding Machines.** Robert S. Burpo, Jr. *Materials & Methods,* v. 24, Oct. '46, p. 945.

Data given in table.

20-472. **Machining of Plain Bearings With Single-Point Tools. Part III.** P. Grodzinski. *Petroleum,* v. 9, Oct. '46, p. 244.

Details of technique which should be used in production of high-quality bearings with shortest possible production time.

20-473. **Machining Troubles Decline When the Metallurgist Sits In.** Norman E. Woldman and Robert C. Gibbons. *American Machinist,* v. 90, Nov. 7, '46, p. 104-108.

Emphasizes value of metallurgy in preventing machining troubles. Recommends closer relationship between the metallurgical, tool design and production departments.

20-474. **Practical Ideas.** *American Machinist,* v. 90, Nov. 7, '46, p. 139-144.

Toolmaker's button and swivel-base trammel speed layouts. Grind punches and dies with proper allowances. Taper-pin puller made from C-clamp. Floating air cylinder gives a two-way squeeze. Combination small tap and die holder fits lathe tailstock. Wide-range adjustable micrometer comparator. Rotary bender handles cold rolled strip. Redesigned air nozzles solve cleaning problems.

20-475. **Tooling the Automatic Screw Machine, XVIII. (Continuation.)** Noel Brindle. *Modern Machine Shop,* v. 19, Nov. '46, p. 124-132, 134, 136.

Second-operation tools and methods for the automatic screw machine. Costs of second operation are as important as first operation.

20-476. **Ideas From Readers.** *Modern Machine Shop,* v. 19, Nov. '46, p. 208, 210, 212, 214, 216, 218.

Preparing bearing shells for babbitting. An improvised automatic drill press feed. Annealing attachment for slitting machine. Method for broaching and sizing square tubular steel frame members.

20-477. **Universal Toolroom Milling Machine.** *Engineering,* v. 162, Oct. 11, '46, p. 345-346, 348.

British machine applicable to horizontal and vertical milling and for the milling of dies and punches with a traversing tool. Its table system enables operations to be done at any angle with a single setup.

20-478. **Internal Grinding Practice. Part 2.** John E. Hyler. *Machine Tool Blue Book,* v. 42, Nov. '46, p. 249-260.

Advantages in using high-quality grinding compounds and proper lubricant; importance of maintaining wheels at recommended speeds; sizing devices for control of hole sizes; various attachments for grinding machines.

20-479. **Surface Grinding With Cylinders & Segmental Wheels.** J. C. Arndt and W. S. Hallowell. *Machinery (London),* v. 69, Oct. 3, '46, p. 417-423.

Types of machines used and examples of work ground with cylinder and segmental wheels.

20-480. **The Determination of Machinability.** G. Schlesinger. *Machinery (London),* v. 69, Oct. 3, '46, p. 425-430.

How the tangential component of the cutting force in turning a test piece can be used as a reliable measure of machinability.

20-481. **Electronic Controls for Precision Grinding Machines.** *Machinery (London),* v. 69, Oct. 3, '46, p. 431-432.

Great advantage of method described is the almost entire absence of moving parts, these being confined to telephone relays. It is necessary only to set a controlling knob at the desired point for time-lag at "dwell" or sizing point, and in this way the most critical phase of grinding, namely, the sparking out period, is taken out of the hands of the operator.

20-482. **Eccentric Clamps for Jigs and Fixtures.** W. H. Litten. *Machinery (London),* v. 69, Oct. 10, '46, p. 453-458.

Self-locking conditions and design dimensions.

20-483. **Machinability, Tool Life and the Machine Tool.** G. Schlesinger. *Machinery (London),* v. 69, Oct. 10, '46, p. 463-467.

How the tool shape can be standardized, and how tool-life tests may be taken by the one-component tool dynamometer, together with machine efficiency determinations.

20-484. **Tools Make the Job.** *Western Machinery and Steel World,* v. 37, Oct. '46, p. 90-93, 126.

Equipment and procedures employed at Victor Equipment Co. in the manufacture of cutting and welding torches.

20-485. **Specialists Versus Run-of-Shop.** *Western Machinery and Steel World,* v. 37, Oct. '46, p. 102-103, 137.

A few examples of comprehensive first-operational use of screw machine. Shows parts made at the Automatic Screw Machine Co.'s Los Angeles plant.

20-486. **Tool Life and the Selection of Carbide.** Raymond O. Catland. *Western Machinery and Steel World,* v. 37, Oct. '46, p. 116-118, 137.

Effects of various influences on tool life when milling cast iron. (To be continued.)

20-487. **What Production Engineers Would Like in the Way of New Machine Tools.** William F. Pioch. *Machinery,* v. 53, Nov. '46, p. 188-189.

Among them are: leakproof hydraulic systems; more rigid tool spindles, adapted for use of improved cutting materials such as the sintered carbides; flush-mounted electrical equipment to increase safety and improve appearance; symmetrical contours, free from protruding ribs.

20-488. **Broaching Thirty-Three Internal Involute Splines in One Operation.** *Machinery,* v. 53, Nov. '46, p. 210.

Thirty-three involute splines are finish-broached in 8½-in. diameter steel clutch driving-ring plates in a single pass on the 30 by 54-in. stroke vertical pull-down broaching machine shown.

20-489. **Tool Engineering Ideas.** Edward Lay. *Machinery,* v. 53, Nov. '46, p. 215-216.

Indexing device eliminates rejections and increases output of work by 75%.

20-490. **Machinability Versus Physical Properties—an Example.** M. Eugene Merchant. *Metal Progress,* v. 50, Nov. '46, p. 1013-1019.

Two samples of steel of same composition and microstructure machine very differently. These differences are shown to be related to the shear strength of the metal when cut, the coefficient of friction between the flowing chip and the face of the cutting tool, and the rate of change of the shear strength with applied compressive stress. Alignment charts for computing these values are given.

20-491. **Dust From Magnesium Alloys.** *Chemical Age,* v. 40, Oct. 19, '46, p. 471.

Arrangement of dust collectors in magnesium machining operations, as a safety precaution.

20-492. **Machine Downtime Reduced by Cutting Tool Protection.** John T. Smith. *Production Engineering & Management,* v. 18, Nov. '46, p. 55-58.

A re-usable plasticized composition applied to cutting tools for protection in handling and storage at Detroit Diesel is paying off in greater productive time and fewer tool regrinds.

20-493. **Production Data Sheet.** *Production Engineering & Management,* v. 18, Nov. '46, p. 83.

Tabulates standard keyway broaches as adopted by Broaching Tool Institute.

20-494. **The Crib—Ideas, Kinks, Short Cuts.** *Production Engineering & Management,* v. 18, Nov. '46, p. 85.

Welded socket wrench; removing cut-off burrs; simple spinning tool.

20-495. **The Broaching of Brasses and Bronzes. Part I.** Harry H. Gotberg. *Tool & Die Journal,* v. 12, Nov. '46, p. 87-92.

Classifies machinability of copper, brass and bronze and discusses various features of broach design.

20-496. **Modern Production Equipment.** Joseph Geschelin. *Automotive and Aviation Industries,* v. 95, Nov. 1, '46, p. 30-35, 58, 60.

Modern equipment, conveyerization and mechanization of operations and assembly lines, as well as the introduction of advanced methods at Studebaker plant. Connecting rod assembly—operation and equipment.

20-497. **The New Involute Spline Standard. The Broaching Institute.** *Tool Engineer,* v. 17, Nov. '46, p. 27-29.

New system provides for remarkable advantages and flexibility in design.

20-498. **Milling Attachments and Accessories.** John E. Hyler. *Tool Engineer,* v. 17, Nov. '46, p. 41-44.

Various types of standard commercial appliances which widen range and versatility of horizontal and vertical millers.

20-499. **New Abrasive Reduces Grinding Costs.** John Anthony. *Iron Age,* v. 158, Nov. 21, '46, p. 56-59.

Extended field tests on a new type of fused alumina abrasive indicate the possibilities for lowered cost in grinding operations. Advantages include the need for fewer redressings and cooler and faster cutting. In addition to a discussion of the results of comparative tests, outstanding features are included.

20-500. **Buick Modernizes Cylinder Bore Production.** H. E. Linsley. *Iron Age,* v. 158, Nov. 21, '46, p. 65-68.

Precision boring and honing, air gaging, and selective piston fitting are combined with a chemical treatment to produce desired results.

20-501. **How to Measure Machinability in the Shop.** Georg Schlesinger. *American Machinist,* v. 90, Nov. 21, '46, p. 117-128.

Life-long tests of various methods of determining machinability and tool life; table of cutting speeds and a simple one-element dynamometer.

20-502. **Practical Ideas.** *American Machinist,* v. 90, Nov. 21, '46, p. 135-140.

Floating punch holder aligns itself in high-speed riveting. Improved centerless grinder work supports shorten setups. Wood vise jaws break nozzle bottleneck. Misaligned two-stage die saved by adjusting the guides. Hints on small tools. Positive shut-off improves exposed push-button stations.

20-503. **Production Drilling of Rail Sections.** *Steel,* v. 119, Nov. 25, '46, p. 66-67, 101.

New method of piercing rail sections reduces time involved as sections up to 39 ft. in length are drilled for reinforced switch points, frogs and crossings.

20-504. **A Handy Sawing Method.** Robert Mawson. *Materials & Methods,* v. 24, Nov. '46, p. 1229.

A short-cut method for making a die on a DoAll machine.

20-505. **Advantages of Speed in Machining.** R. Delamare. *Materials & Methods,* v. 24, Nov. '46, p. 1264-1265.

Advantages of high speed made possible by use of carbide tools are: No built-up edge is formed because of the brief contact between tool and material being cut; there is no time for secondary vibrations; power consumption is decreased while tool and machine life is increased; a better finish is obtained; the high speed causes heating and softening of the surface of the material being cut so that removal of chips is facilitated, while there is not enough time for much of the heat to be transmitted to the tool. (Condensed from *Mecanique,* v. 30, Feb. '46, p. 29-36.)

20-506. **Machining of Stainless Steels.** W. H. Crisp and W. Burnan. *Aircraft Production,* v. 8, Nov. '46, p. 529-532.

Some precautions to insure satisfactory results in turning, drilling, tapping and other processes.

20-507. **Gear Box Manufacture.** *Automobile Engineer,* v. 36, Oct. '46, p. 429-438.

Gear box incorporates certain unusual features, including constant mesh on all four speeds and a positive gear lock. Manufacturing methods employed for several important components, and operation sequences for the box itself, the mainshaft, a mainshaft gear, a sliding dog, and a center for sliding dog. All gears must pass comprehensive inspection.

20-508. **Gear Shaving.** *Automobile Engineer,* v. 36, Oct. '46, p. 443-450.

Principles underlying the process; the cutters used, both rack and rotary; chip removal; cutting fluids for the shaving operation.

20-509. **Machining Wheels and Axles for Railway Rolling Stock.** *Machinery (London),* v. 69, Oct. 17, '46, p. 481-486.

Equipment and procedures at Taylor Bros. & Co., Ltd., England. Sequence of operations on duplex boring and

turning mills, drilling and trepanning, axle machining and pressing of wheels onto axles.

20-510. **Toolmaking Methods.** *Machinery (London),* v. 69, Oct. 17, '46, p. 493-497.

Some representative methods used in the making of special-purpose gages and tools to insure their accuracy without unduly increasing cost.

20-511. **Slot-Drilling Jig With Half-Bushing Guide for Drill.** H. Moore. *Machinery (London),* v. 69, Oct. 24, '46, p. 515.

Jig with a reversible bushing plate for drilling three closely spaced holes through shaft to produce a crosswise slot.

20-512. **Eccentric-Clamp Application.** W. H. Litten. *Machinery (London),* v. 69, Oct. 31, '46, p. 551-555.

How the eccentric cam may be used in a variety of ways on jigs and fixtures and in the machine shop generally.

20-513. **Blind-Bore Lapping.** H. J. Richards. *Machinery (London),* v. 69, Oct. 31, '46, p. 556-557.

Improvements in techniques in production of master ring gages to 0.00002-in. accuracy.

20-514. **Cam to Give Longer Stroke Without Increased Operating Space.** *Machinery (London),* v. 69, Oct. 31, '46, p. 558-559.

Cam shown serves to impart a reciprocating motion to the machine slide which is required to have a longer stroke than could be produced by a cam of conventional design and of a size which could be assembled in the recess. Cam was designed to provide the long stroke required without increasing the diameter of the cam.

20-515. **Cutting Action of Reamers.** T. F. Githens. *Transactions of the American Society of Mechanical Engineers,* v. 68, Nov. '46, p. 867-876.

Fundamental action, design, and maintenance of reamers.

20-516. **Machining Wheels and Axles for Railway Rolling Stock.** *Machinery (London),* v. 69, Nov. 7, '46, p. 579-583.

Methods employed at the Works of Owen & Dyson, Ltd., for completely machining the wheels and axles separately, leaving the pressing-on of the wheels for the final operation. Resulting product is much more accurate than formerly, apart from the improved finish which is obtained with considerable reduction in machining times.

20-517. **Form Tools. (Continued.)** William F. Walker. *Edgar Allen News,* v. 25, Nov. '46, p. 709.

Steel-cutting carbides; composition and heat treating schedules for oil hardening, nonshrinking toolsteel. (To be continued.)

20-518. **Automatic Pneumatic-Indexing Drilling Jig.** *Engineering,* v. 162, Nov. 8, '46, p. 440-441.

Jig has been devised to reduce the time taken in clamping small components in drilling jigs and in removing them after drilling.

20-519. **Drilling Closely Spaced Multiple Holes.** *Iron Age,* v. 158, Dec. 5, '46, p. 71.

By combining two standard Zagar products, seven sizes of holes, ranging from No. 40 to $\frac{5}{32}$ in., are drilled into a socket part at very close distances. The spindles are spread over a predetermined distance, and alternate holes are drilled at various positions by the indexing method.

20-520. **Precision in Brass.** Ralph G. Paul. *Western Machinery and Steel World,* v. 37, Nov. '46, p. 92-95.

Equipment and operations at National Welding Equipment Co., manufacturers of welding torches, cutting torches, regulators and accessories for the metalworking industries, as well as a wide variety of specialized gas-air equipment items.

20-521. **Modern Methods of Gear Finishing.** Peter Starman. *Western Machinery and Steel World,* v. 37, Nov. '46, p. 100-103, 126, 129.

Importance of accuracy of gear blanks and condition of materials. Relative advantages of rack and rotary methods of gear shaving.

20-522. **Contour Machining for Material Economy.** H. J. Chamberland. *Western Machinery and Steel World,* v. 37, Nov. '46, p. 105-107.

Examples of eight applications of contour sawing, taken at random from production facts, resulting in saving of approximately 1000 lb. of die steel.

20-523. **Electric Control for Metalworking Machines.** James Van Voast. *American Machinist,* v. 90, Dec. 5, '46, p. 117-132.

Circuit elements; current "changers"; starters; adjustable-speed drives; automatic controls; wiring and standardization.

20-524. **Practical Ideas.** *American Machinist,* v. 90, Dec. 5, '46, p. 139-144.

Toolmaker's buttons establish accurate angles and straight edges. Special drilling. Handy solder holder. Hinge lifts planer tool clear of deep slots. Powered toolbit honer produces sharper tools. Flat gage repositions toolbits in square turrets. Hints on small tools. Extension center permits accuracy on old lathes. Chipbreakers brazed on when they can't be ground. Angle plate clamp for grinding setups. Hand punch and die for light sheet metal work. Soft hexagonal false jaws improve finish operations.

20-525. **Oil Casings.** J. H. List. *Iron and Steel,* v. 19, Nov. '46, p. 601-602.

Machining operations for 90° gear drive housings.

20-526. **Electronic Contouring Control.** J. M. Morgan. *Steel,* v. 119, Dec. 9, '46, p. 94-96, 116, 119.

Simplifies machining of odd-shaped parts accurately and "steplessly". Besides providing high degree of flexibility of setups, it maintains tool travel at constant linear rate.

20-527. **Notes From British Experience in Milling Light Alloys.** E. R. Yarham. *Modern Machine Shop,* v. 19, Dec. '46, p. 124-132, 134.

Production of spar booms for aircraft as an example

of the application of carbide tipped cutters in machining alloys. Methods used in Britain illustrate certain broad principles which will apply generally to the high-speed milling of such metals.

20-528. **Building High Output Diesel Engines.** Joseph Geschelin. *Automotive and Aviation Industries,* v. 95, Dec. 1, '46, p. 18-24, 37.

Operations and equipment involved in production of cylinder liner, vapor compressor cylinder, cylinder head, and blower. Advanced techniques in machining rotors and housings.

20-529. **Crushed Wheel Grinding.** J. C. Wilson. *Tool Engineer,* v. 17, Dec. '46, p. 35-39.

Early development; machine requirements; table speeds; crushing devices; crushing rolls; coolants; grinding wheels.

20-530. **Milling Attachments and Accessories. Part 2.** John E. Hyler. *Tool Engineer,* v. 17, Dec. '46, p. 46-49.

Multispindle heads; micrometer setting attachments; contouring attachments and other fixtures. (Concluded.)

20-531. **Machining Huge Aluminum Slabs on Scalper of Unusual Design.** *Machinery,* v. 53, Dec. '46, p. 150.

Machines scalp the surface of the slab to a depth of ¼ to ⅜ in. in one pass of the table, thus preventing impurities from being distributed throughout the sheet in later operations. Scalping machines employed for this work are a horizontal-spindle type. In appearance and operation, they resemble a vertical-spindle milling machine that has been turned 90° to a horizontal operating position. Will handle slabs weighing from 200 to 10,000 lb. and ranging in size from 2x30x38 in. to 16x63x120 in.

20-532. **Chip-Removal and Coolant-Temperature Regulating System.** *Machinery,* v. 53, Dec. '46, p. 151-154.

Centralized collection of chips, regulated coolant temperature, and consequent increased production are advantages derived from installation which consists of chip-removal conveyers, coolant storage tanks, and a ventilation system, built as a unit and designed to serve groups of three or four machines. Installation described serves a group of four Bullard vertical turret lathes. Lathes are used for machining cast-iron automotive brake drums.

20-533. **Tool Engineering Ideas.** *Machinery,* v. 53, Dec. '46, p. 175-177.

Lathe attachment for cutting oil grooves. Fixtures for grinding the under side and top of machine tool ways parallel. Automatic feeding and ejection of small cylindrical parts.

20-534. **Carbide-Ball Burnishing Cuts Bore-Finishing Cost 90%.** James Busch. *American Machinist,* v. 90, Dec. 19, '46, p. 129.

For each size of blank, a special burnishing fixture has been developed. The one for the larger blank is shown; that for smaller blank is identical but somewhat smaller in over-all dimensions.

20-535. **Practical Ideas.** *American Machinist,* v. 90, Dec. 19, '46, p. 139-144.

Floating driver speeds mandrel-mounted work. Taper pin locks taper shank boring bars. Double-eccentric circular cutters improve reaming. Expanding mandrel permits quick work changes. Different drillrods set correct tapers. Drillrod tool cuts ball ends on knobs and links. Altered tube fittings meet the deadline. Heavy-duty layout cube combines angle plate and V-blocks. Lower your hacksaw grip for better cutting. Old rag stops chatter in countersink milling. How to square fractions. Large bushings sensitively installed in close quarters. How to measure the radius of a short circular arc.

20-536. **Gear Shaving. Part II.** *Automobile Engineer,* v. 36, Nov. '46, p. 481-486.

Various types of gear shaving machines manufactured by the National Broach and Machine Co. and the Michigan Tool Co., Detroit. Methods of operation and the machine capacities. Details of gear shaving practice employed by Ford Motor Co., Ltd., Dagenham. Reasons for adopting gear shaving as a finishing process; speeds, feeds and production rates for typical gears; reference to the cutting fluids used and the heat treatment employed.

20-537. **Toolmaking Methods and Calculations.** *Machinery (London),* v. 69, Nov. 14, '46, p. 625-629.

Depth gage for formed hole; tapered gap gage; fixture for timing gear; form gage for three blended radii; uses of the light box; checking splined work.

20-538. **Helical Cutters With Adjustable Blades.** C. F. Smith. *Machinery (London),* v. 69, Nov. 14, '46, p. 633.

Helical cutter with blades that can be adjusted to permit regrinding or sharpening to the original diameter.

20-539. **Production of Flat Surfaces.** R. J. M. Whibley. *Machinery (London),* v. 69, Nov. 14, '46, p. 634-639.

Preparation of samples produced by planing, vertical milling, negative-rake milling, toolroom surface grinding and surface broaching.

SECTION XXI

LUBRICATION AND FRICTION

21-1. **How to Lubricate Metal Working Machines.** Harold L. Flynn. *American Machinist,* v. 89, Dec. 20, '45, pp. 113-128.

Various types of lubricants, devices, and systems described and their applications in various units of equipment.

21-2. **Lubrication in Drawing Aluminum.** Samuel Spring. *Steel,* v. 117, Dec. 24, '45, pp. 78-79, 98-101.

Frictional characteristics of aluminum during drawing frequently result in loading or fouling tools, despite small force required for plastic deformation of many alloys. Various combinations of lubricants used to alleviate this tendency; tool design for minimizing ironing and other factors. 19 ref.

21-3. **Lubrication.** Henry Vita. *Metal Industry,* v. 67, Nov. 23, '45, p. 341.

Recommendations for forging and stamping aluminum alloys.

21-4. **Lubrication in Drawing Magnesium.** Samuel Spring. *Steel,* v. 117, Dec. 31, '45, pp. 64, 66.

Metallurgical and engineering factors governing choice and use of lubricants to facilitate press-forming of magnesium discussed. 6 ref.

21-5. **Lubricants.** *Automotive & Aviation Industries,* v. 93, Dec. 15, '45, pp. 27, 29, 74, 76, 78.

Problems involved in airframe lubrication; silicones as lubricants; aviation lubricating oils; performance testing of wheel-bearing lubricants.

21-6. **Aluminum-Alloy Bearings.** *Light Metals,* v. 8, Dec. '45, pp. 579-591.

Development, properties, uses and advantages of aluminum-base alloy bearing materials. (Translated from *Technische Rundschau,* no. 41, Oct. 6, 44 and no. 42, Oct. 13, '44.)

21-7. **Antifriction Bearings Change Sliding Friction to Rolling.** C. W. Pearsall. *Power,* v. 90, Jan. '46, pp. 86-87, 148, 150.

Development of ball and roller bearings, their purpose, advantages, construction, standard parts, and how they transmit radial, thrust and combined radial-thrust loads.

21-8. **Versatility of the Ball: Part IV—Modern Machinery Applications.** H. F. Williams. *Machine Tool Blue Book,* v. 42, Jan. '46, pp. 213-214, 216, 218, 220, 222, 224, 226, 228, 230, 232, 234, 236.

Not only can it be used to function as an anti-friction part on the one hand and a frictional component on the other, but it can be applied as a metal forming tool, a handle, sizing device, gage, center, swivel, pressing tool, valve and as an equalizer in vise and other holding arrangements.

21-9. **Good Grinding and Honing Methods Speed Production.** Paul H. Krupp. *Machine Tool Blue Book,* v. 42, Jan. '46, pp. 291-294.

Recommends use of localized filtering method to assume sludge-free coolant and type of coolant solution necessary for best results. Discusses advantages.

21-10. **Machine Tool Lubrication.** P. E. Bundy. *Iron Age,* v. 157, Jan. 10, '46, pp. 72-73.

Importance of a properly integrated lubrication program is stressed; system for reducing oil costs by periodic inspection and filtration.

21-11. **"Hydrauto" Bearing for Grinding Machines.** *Engineering,* v. 160, Dec. 14, '45, pp. 492-493.

A form of bearing for grinding machines which automatically adjusts the running fit to the working conditions by means of a hydraulic device.

21-12. **Nickel-Antimony-Lead-Copper Bearing Alloys.** John T. Eash. *Metals Technology,* v. 12, Dec. '45, T. P. 1937, 11 pp.

Such properties as microstructure, hardness, compressive yield strength, ductility, and castability have been considered, and certain simple wear tests have been made. Conclusions given. 11 ref.

21-13. **New Saw Lubricant.** *Iron Age,* v. 157, Jan. 17, '46, p. 68.

New compound is dry lubricant containing turpentine, mineral oil, wax and other materials. Tests of the saw lubricant revealed that a Yates-American saw equipped with a 1-in. blade used only three blades during an 8-hr. day compared to ten blades a day before the lubricant was applied.

21-14. **Silver.** *Metal Industry,* v. 68, Jan. 4, '46, pp. 13-14.

Its use as a bearing material. 4 ref.

21-15. **Lubricating-Oil Maintenance by Continuous Clarification.** Walter C. Bauer. *Industry & Power,* v. 50, Jan. '46, pp. 71-72.

Explains the value of continuously maintaining oil in prime condition and free of contaminants.

21-16. **Economy of Specially Processed Graphitized Soluble Oil.** H. J. Chamberland. *Screw Machine Engineering,* v. 7, Jan. '46, pp. 55-58.

Deals specifically with DoAll 470 soluble oil, a specially processed colloidal graphite oil. Efficiently replaces a variety of straight cutting and soluble oils generally used, is economical in relation to screw machine, turret lathe and grinder production.

21-17. Bearing Design and Installation in High Speed Superchargers. Zola Fox. *Product Engineering,* v. 17, Jan. '46, pp. 8-11.

Fundamental requirements that must be considered in the design of bearings and methods of lubrication for high-speed superchargers. Advantages and disadvantages of ball, roller and plain bearings discussed. Types of floating bushings, nut locking devices and thrust collar details illustrated and described.

21-18. Constant Delivery of Clean Oils Boosts Output and Saves Equipment. Philip C. Booty. *American Machinist,* v. 90, Feb. 14, '46, p. 122-125.

Conveyorized chip troughs and pumps speed contaminated oils to a central reclamation and storage area for distribution to all plant production lines.

21-19. Aluminum Bearings. *Product Engineering,* v. 17, Feb. '46, p. 128-130.

Various tests and uses of aluminum alloys La 11, La 21 and La 31; advantages cited. Table gives mechanical properties of aluminum bearing alloys. (Foreign abstract condensed from an article by A. Deck in *Technische Rundschau,* Oct. 6 and 13, '44.)

21-20. Extra-Thin Large-Diameter Bearings. *Iron Age,* v. 157, Feb. 21, '46, p. 61.

Developed for a special wartime application, 32-in. and 33-in. diameter ball bearings have a width of only ¾ in., and present some extraordinary problems in handling and heat treating to avoid distortion.

21-21. Coolants Can Be Kept Clean. *Screw Machine Engineering,* v. 7, Feb. '46, p. 48-51.

Several interesting case histories featuring filtration of coolants.

21-22. Lubrication Between Piston Rings and Cylinder Walls. J. S. Courtney-Pratt and G. K. Tudor. *Engineering,* v. 161, Jan. 18, '46, p. 69-71.

Further insight into the lubrication conditions and factors influencing wear can be obtained by studying the instantaneous variation of metallic contact, rather than by making direct measurements of average rates of wear. This instantaneous variation may be studied by measuring the electrical conductance across the moving surfaces.

21-23. Running Steel in Contact Without Lubrication. R. C. Edwards. *Iron Age,* v. 157, Feb. 28, '46, p. 56-57.

Test rings and blocks were made of S.A.E. 52100 and hardened to Rockwell C-58, and the contacting surfaces were ground to 18.5 micro-inches. Ring was rotated against the block at a surface speed of 400 fpm. with a 12-lb. load, and the test was run until the first sign of scoring appeared on the ring surface. Both surfaces were then observed, and the running time recorded. The test was then continued for 10 min. An outline of the test procedure and the results of the test are shown.

21-24. Bearing Corrosion. Part 3. H. H. Zuidema. *Oil and Gas Journal,* v. 44, March 2, '46, p. 66, 69-70, 72.

Results of laboratory investigations. 42 ref.

21-25. **Coolants for Machining Operations.** *Materials and Methods,* v. 23, Feb. '46, p. 475.

For drilling, reaming and tapping.

21-26. **Conditioning Coolants in a Centralized Sump.** Carl Brandquist. *Factory Management and Maintenance,* v. 104, March '46, p. 149-150.

By installing a large water-cooled centralized coolant sump and circulating system for each of two banks of 12 automatic screw machines in the machining department of Mills Industries, Chicago, it is now possible to keep these machines constantly supplied with a cool and clean coolant. Job of cleansing coolant and supplying make-up coolant to each machine simplified.

21-27. **Versatility of the Ball, Part IV.** H. F. Williams. *Machine Tool Blue Book,* v. 42, March '46, p. 139-140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164.

Miscellaneous applications.

21-28. **Inhibitors in Turbine Oils Reduce Oxidation and Prevent Rust.** *Power,* v. 90, March '46, p. 87-89, 140.

Results of recent tests for these important properties: oxidation stability and rust prevention.

21-29. **Motor Bearing Maintenance Is Doubly Important.** G. L. Ringwald. *Industry and Power,* v. 50, March '46, p. 76-78.

Proper operation temperatures; tightness of ball bearing races and lubrication sleeved bearing design and grooving; bushing and bushing materials.

21-30. **Simplified Line-Up of Modern Drawing Compounds.** *Modern Industrial Press,* v. 8, March '46, p. 6.

E. F. Houghton and Co. announces six compounds developed to meet all demands for cold drawing of metals.

21-31. **Grease Lubricants.** J. C. Van Gundy. *Steel,* v. 118, March 25, '46, p. 92-94, 111, 114, 116, 118.

Properties and limitations of seven types: *(a)* calcium soap base or cup grease; *(b)* calcium resinate soap base or axle grease; *(c)* sodium soap base (general); *(d)* sodium soap base (brick grease); *(e)* aluminum soap base; *(f)* lithium soap base; *(g)* mixed base greases.

21-32. **The Spraying of Gear Lubricants.** D. E. Whitehead. *Iron and Steel Engineer,* v. 23, March '46, p. 68-72.

Advantages gained through utilization of the spray application and spray lubricants as compared to the common practice of applying residual petroleum lubricants (gear shield) to gears by swabbing or pouring. Tests described utilizing bronze and babbitt test blocks, the compositions of which are listed. Timken test machine was employed, using the standard grease test procedure.

21-33. **Split Ball Bearings.** *Steel,* v. 118, April 1, '46, p. 136-137, 178.

Developments of divisible-race or split bearing fills "vacancy" in antifriction field. Makes for simplicity of replacement in units where downtime is serious factor. Manufacture; assembly; grinding.

21-34. **Heat of Wetting of Metal Surfaces by Oils.** H. H. Herbst. *Petroleum Refiner,* v. 25, March '46, p. 121-125.

Proposes that the heat of wetting of metals by oils be carried out directly on the smooth metal or bearing metal itself. Apparatus to determine the heat of wetting of metals by various oils, colloids, etc. (Translated by E. J. Barth from *Kolloid Zeitschrift,* v. 71, no. 3, 1935.)

21-35. **Babbitting Large Cast-Iron Bearing Shells.** L. F. Train. *Iron Age,* v. 157, April 4, '46, p. 84-85.

Tinning bath construction; removing dross accumulations.

21-36. **High-Duty Engines—a Consideration of the Various Problems Involved in Development.** A. Towle. *Automobile Engineer,* v. 36, March '46, p. 105-113.

How practical research has contributed to the development of some of the world's most successful aero engines. Tests on main bearings showed that most suitable materials are lead bronze alloys containing a small percentage of tin or plain silver. The antiseizure properties are increased by lead plating, and for high oil temperatures indium treatment is necessary. A higher fatigue resistance is necessary for connecting-rod bearings. Fatigue tests on connecting-rod bolts also described.

21-37. **Selecting Drawing Compounds for Presswork.** James McElgin. *Machinery,* v. 52, April '46, p. 157-159.

Importance of film strength in drawing compounds; oiliness of compound and friction between die and work; evaluating the cost factors in selecting drawing compounds; standardization of ball and roller bearing sizes.

21-38. **Durex-100 Engine Bearings—Material Characteristics and Design Data.** J. A. Lignian. *Product Engineering,* v. 17, April '46, p. 335-339.

Characteristics and construction of the Durex-100 engine bearing. Design of bearings discussed with particular reference to the use of this material, and methods of obtaining crush stresses in bearing shells. Sample calculations illustrate the method.

21-39. **Charts for Fluid Friction Bearing Design—I.** H. W. Hamm. *Product Engineering,* v. 17, April '46, p. 351-352.

Charts constructed as an aid in the design of bearings operating under fluid friction. Sketches accompanying chart illustrate typical oil grooving for fluid friction bearings of the split and solid bushing type.

21-40. **Film Lubrication Between Spherical Surfaces With an Application to the Theory of the Four-Ball Lubricant Testing Instrument.** J. Howlett. *Journal of Applied Physics,* v. 17, March '46, p. 137-149.

Flow of viscous liquid between the outer surfaces of two equal spheres placed in infinite body of liquid so that "minimum separation" of surface is small compared with radius; one sphere is held at rest, other rotates at constant speed about axis which does not pass through center of sphere.

21-41. **The Comprehensive Laboratory Testing of Instrument Lubricants.** G. E. Barker, G. E. Alter, C. E. McKnight, J. R. McKlveen and D. M. Hood. *ASTM Bulletin,* no. 139, March '46, p. 25-35.

Following properties (which are among most essential characteristics of a good instrument lubricant) are readily measured in the laboratory: viscosity; cloud and pour points; oxidation stability and corrosion of brass; corrosion and rusting of steel; evaporation; spreading; and coefficient of friction of steel on sapphire, lubricated. If conducted in proper sequence, the seven tests listed can be performed on a 1-oz. specimen. Careful consideration given to the simplicity of apparatus and procedure. 13 ref.

21-42. **Factors in the Selection of Cutting Fluids for the Die-Casting Alloys.** R. I. Mahan. *Die Casting,* v. 4, May '46, p. 58-60.

Advantages to be gained by selection of proper cutting fluid are: faster metal removal; improved surface finish; improved dimensional accuracy; longer tool life.

21-43. **Bearing Failures—Causes and Cures.** R. W. Dayton and R. E. Adams. *Machine Design,* v. 18, May '46, p. 113-116.

Types of bearing failure; hydrodynamic lubrication; mechanism of hydrodynamic lubrication; reasons for failure; design factors which influence seizure; other frictional failures; mechanical failures of bearings. 19 ref.

21-44. **Lubricant Selection Simplified.** James G. O'Neill. *Machine Design,* v. 18, May '46, p. 161-164.

General lubrication charts. Various types of mechanical equipment, including engines, turbines, motors, pumps, machine tools, gear reducers, couplings, drives, and shafting, as well as specialized steel mill requirements.

21-45. **Extreme-Pressure Lubricants.** Ben F. Hunter. *Steel,* v. 118, May 20, '46, p. 118, 120, 122.

Bright future foreseen for sulphur-bearing oils and greases in metalworking industry. Metallic sulphides formed by "extreme pressure" lubricants used for gears minimize galling and scuffing. Better grades noncorrosive to metals.

21-46. **Design and Performance of Plastic Rolling Mill Bearings.** O. K. Graef. *Steel,* v. 118, May 27, '46, p. 116-120, 138, 140, 142.

Twelve principles underlying the operation of nonmetallic bearings and based on extended campaigns prevent many failures. Power savings on old mills are made possible by alleviating certain conditions. Changes in impingement velocity and in distribution of coolant-lubricant afford saving in water requirement.

21-47. **Characteristics of Coolants and Cutting Fluids.** J. R. Chambers. *Machinery (London),* v. 68, May 9, '46, p. 597-9.

Purposes served by cutting fluids; base oils used in cutting metals; mineral oils used for machining processes; cutting lubricants for steel and cast iron; cutting compounds for brass; machining aluminum alloys; cutting fluids for magnesium alloys.

21-48. **Tests of Oil-Film Journal Bearings for Railroad Cars.** S. J. Needs. *Transactions of the American Society of Mechanical Engineers,* v. 68, May '46, p. 337-353.

Results of a special series of tests made with fitted and broached railway-car journal bearings as part of the pro-

gram of the Journal Bearing Development Committee of the Association of American Railroads. Three recently developed bearings, each containing less bronze than the old standard A. A. R. bearings, were tested. Quantitative effects of fitted and broached bearing surfaces and method of lubrication on operating temperature, frictional power loss, and the all-important minimum film thickness are given.

21-49. **Dimethyl-Silicone-Polymer Fluids and Their Performance Characteristics in Unilaterally Loaded Journal Bearings.** J. E. Brophy, R. O. Militz, and W. A. Zisman. *Transactions of the American Society of Mechanical Engineers,* v. 68, May '46, p. 355-360.

Specially designed bearing machine was used having forced-feed lubrication up to pressures of 26 psi. It was operated at a speed of 1725 r.p.m., and the oil-sump temperatures varied from 115 to 130° F., while the bearing temperatures varied from 150 to 240° F. Plain or chromium-plated high-carbon steel shafts were used in conjunction with bearings of copper-lead, bronze, tin-base babbitt, cast iron, commercial brass, aluminum (17S), copper and Al-Fin metal. Method of pretreatment described. Such pretreated bearings were able to carry much higher than normal loads when operated in contact with petroleum lubricating oil.

21-50. **Important Engineering Data on Aluminum Alloy Bearings for Engines.** D. B. Wood. *Automotive and Aviation Industries,* v. 94, June 1, '46, p. 26-30, 74, 76, 78.

Three aluminum alloy bearing materials have been developed by Aluminum Co. of America for use in high-duty engines as connecting rod, main and thrust bearings. These materials, namely, alloys 750-T533, XA750-T7, and XA80S, in laboratory and field tests have proved capable of giving outstanding performance and withstanding severe operating conditions.

21-51. **Factors in the Selection of Cutting Fluids for the Die-Casting Alloys. Part 2.** R. I. Mahan. *Die Casting,* v. 4, June '46, p. 54-55, 57-58.

What they should do; types; specific machining operations; cutting fluids for zinc alloys; cutting fluids for copper alloys. Includes table of recommendations.

21-52. **Some Observations on Cut Necks in Rolling Mill Practice.** G. P. Contractor and S. Viswanathan. *Sheet Metal Industries,* v. 23, June '46, p. 1087-1096.

While the examination of cut necks is mainly metallurgical, both as regards bearing material and roll and roll-neck metal, observations on lubrication are included.

21-53. **Calculation of the Performance Characteristics of Plain Bearings.** A. Frankel. *Engineers' Digest (American Edition),* v. 3, May '46, p. 223-227.

The author has developed a mathematical basis for calculating cylindrical plain bearings of finite width which permits estimating, with little expense of effort and time, the pressure distribution, resulting load, frictional torque, oil flow, etc., for any given bearing width and relative eccentricity. (Abstract, *Mitteilungen aus dem Institut fur*

Thermodynamik und Verbrennungsmotorenbau, Eidgenossische Technische Hochschule Zurick, no. 4, 134 p.)

21-54. **Sliding Friction Under Extreme Pressure—I.** S. J. Dokos. *Journal of Applied Mechanics,* v. 13, June '46, p. A148-A156.

Concerned with the evaluation of the frictional forces which occur under very high contact pressures and under varying conditions of speed, temperature, and lubrication. The work presented herein covers the experiments which have been made on sliding friction at normal temperatures.

21-55. **Bearing Failures—Causes and Cures. Part 2.** R. W. Dayton and R. E. Adams. *Machine Design,* v. 18, June '46, p. 128-132.

Galling and wear. Both continuous and reciprocating movement considered.

21-56. **The Manufacture of Wrapped Bushes.** *Machinery, (London),* v. 68, June 6, '46, p. 713-718.

Methods employed by the Glacier Metal Co., Ltd., in the production of a standard range of lead-bronze lined steel-backed bearings.

21-57. **Report of the Automobile Research Committee on Contraction of Aluminum Alloy Bearings.** L. Farkas. *Journal of the Institution of Automobile Engineers,* v. 14, June-July '46, p. 205-228.

Nature and the causes of contraction of aluminum alloy bearings. Previous test results indicated that contraction is due to plastic straining of the bearing material. This is confirmed by calculation of the stresses set up in the bearing alloy, which are caused by the interference fit between bearing and housing and the differential thermal expansion of aluminum alloy and steel.

21-58. **Bearings Without Oil.** Leland B. Watson. *Modern Machine Shop,* v. 19, July '46, p. 158, 160, 162, 164, 166, 168.

For most applications of the type for which wood bearings are suitable, such bearings will carry a lifetime reserve of oil and may be stored for years without losing their self-oiling qualities. They are also nonconductors of heat and electricity and can be machined in every conceivable shape.

21-59. **Industrial Emulsions.** E. H. Kadmer. *Petroleum Refiner,* v. 25, July '46, p. 133-136.

Series of emulsions useful for the metalworking industry, such as for metal cutting, grinding, boring, etc. Tests show that when making mineral oil emulsions greater amounts of emulsifier are consistently needed as the viscosity of the mineral oil increases. Also certain "inherent polar bodies" present in commercial and especially in unrefined oils greatly aid in obtaining good emulsions. Relation between stability and type of dispersions when the system graphite plus oil is emulsified. Several procedures for preparing graphite emulsions for the metalworking industry are referred to. (From *Oel und Kohle,* no. 19-20; May '43.)

21-60. **How to Deliver and Maintain Lubricants.** Harold L. Flynn. *American Machinist,* v. 90, July 18, '46, p. 117-121.

Operation and maintenance of lubricating devices and purifying systems.

21-61. **Instrument Bearing Friction.** A. L. Nylander. *General Electric Review,* v. 21, July '46, p. 12-17.

Factors that minimize bearing-system frictional torque in instruments requiring high sensitivity, and formulas that aid in accurately computing it. Special consideration given to horizontal axis position, wherein maximum error occurs.

21-62. **Cutting Fluids and Chipbreakers.** W. A. Carter. *Engineering,* v. 161, June 21, '46, p. 582-583.

In any metal-cutting operation, when long tool life is of importance, the amount of heat generated and the friction between the chip and tool must be maintained at minimum values. To do this it is necessary in many cases to use coolants for the control of temperature, and lubricants to reduce friction. Cutting fluids are available for these functions. (Abridgment of paper for Conference on Machinability held at the Institution of Mechanical Engineers, London.)

21-63. **Silicone Greases for Bearing Lubrication at High or Low Temperatures.** *Power Plant Engineering,* v. 50, July '46, p. 86-87.

Lubricants being developed from silicone products extend safe operating temperature range of bearings; lubricants developed for ball bearings; certain greases applicable for temperature range from —95 to 300° F., others designed for temperatures from —4 to 482° F., table of specifications given.

21-64. **Dual-Purpose Cutting Fluid.** *Western Machinery and Steel World,* v. 37, July '46, p. 116-117.

Continuing low temperatures accompanied by adequate friction reduction tends to prevent built-up edges on cutter tool faces, lengthens cutter life, improves finishes and lessens heat producing friction.

21-65. **Bond Testing of Silver Plated Engine Bearings.** Frank D. Hallworth. *Automotive and Aviation Industries,* v. 95, July 15, '46, p. 30-33, 64, 66.

Supersonic pulse method, fluorescent penetrant oil method; whirl test, shear test, roll-peen and shot-peen test.

21-66. **A Symposium: Cutting Fluids and Coolants.** *Tool Engineer,* v. 16, July '46, p. 18-28.

The Testing of Cutting Fluids, by D. J. Wangelin; What the Tool Engineer Should Know About Cutting Fluids, by W. H. Oldacre; Cutting Speeds and Feeds, by Frederick W. Lucht; The Selection of Cutting Fluids, by Joseph Geschelin.

21-67. **Gear Life Depends on Good Lubrication.** A. F. Brewer. *Industry and Power,* v. 51, Aug. '46, p. 68-70.

How to recognize and alleviate normal wear, scoring, galling, and pitting—causes of tooth failure.

21-68. **A Short Review of Surface Finish in Relation to Friction and Lubrication.** D. Clayton. *Institution of Mechanical Engineers Proceedings,* v. 153, '45, War Emergency Issue no. 10, p. 332-334.

Surface roughness as a pertinent factor with boundary and dry lubrication and various practical cases of mixed lubrication. (Paper for Symposium on Surface Finish.)

21-69. **Shop Control of Oil Concentration.** E. L. H. Bastian. *American Machinist,* v. 90, Aug 1, '46, p. 126-127.

Spot checking of oil-to-water ratios in emulsifiable cutting fluids pays off in precision work and increased test life.

21-70. **Hydraulic Oils for Industrial Equipment.** J. C. Van Gundy. *Machinery,* v. 52, Aug. '46, p. 158-166.

Review of the qualities of hydraulic oils, the difficulties caused by oxidation, rust, sludge, and foaming, and how they can be overcome, together with suggestions on maintenance and the locating of troubles in hydraulic equipment.

21-71. **Viscosity: Most Important Property of Lubricating Oil.** C. M. Larson. *Power,* v. 90, Aug. '46, p. 68-70.

Defines viscosity and tells how it is measured and compared by standardized methods.

21-72. **Bearings and Bearing Metals.** Bernard O. Brouk. *Journal of the American Society of Naval Engineers,* v. 58, Aug. '46, p. 418-440.

Experimental work on bonding problems, pressure die-cast bearings, centrifugally cast bearings and linings, babbitting, lead-bronze bearings, aluminum alloy bearings, tin substitute bearing metal, corrosion of bearing alloys, and silicone polymers as lubricants. Test methods for determination of bond strength and presence of air bubbles lying between the lining and the body of the bearing are outlined.

21-73. **Lubrication in Relation to Bearing Design.** C. Ridley. *Machinery (London),* v. 69, Aug. 1, '46, p. 144-146.

Review of bearing surfaces. 5 ref.

21-74. **Selecting Nonferrous Bearing Material.** Norman E. Woldman. *Iron Age,* v. 158, Sept. 5, '46, p. 54-57.

Structure, physical properties and proper application of nonferrous bearing alloys are discussed. Babbitts, copper-lead group and single-phase metals such as pure lead and tin are covered.

21-75. **Machining of Plain Bearings With Single-Point Tools. Part 3.** P. Grodzinski. *Petroleum,* v. 9, Aug. '46, p. 188-189.

Theory of bearing lubrication; results of experiments on the relationship of seizure pressure to surface finish; short survey of modern bearing materials and their customary clearances and capacity limits.

21-76. **Report of the Committee on Lubrication.** *Railway Mechanical Engineer,* v. 120, Sept. '46, p. 472-473.

Report on a study of roller bearing lubricants proposes extensive program of further study. Need of magnafluxing after overheating of journals emphasized.

21-77. **Swarf Handling and Oil Storage.** H. M. Harman. *Machinery (London),* v. 69, Aug. 15, '46, p. 193-199.

Specially designed trucks for handling swarf; draining and crushing; equipment for oil reclamation; mixing

tanks for soluble oil; saline settling tanks; some typical installations.

21-78. **Report of Committee on Journal Bearing Development.** *Railway Mechanical Engineer,* v. 120, Sept. '46, p. 470-472.

Emergency designs tested and found satisfactory. Survey made to determine causes for scrapping of bearings. Future development possibilities listed.

21-79. **Removing the "Ants" From Coolants.** D. C. Miner. *Machine Tool Blue Book,* v. 42, Sept. '46, p. 129-130, 132, 134, 136, 138.

Troubles come in in the sludge, rusting of the work, decomposition of the coolant, dermatitis, rancidity, and burning of the work. Reviews the whole situation and tells what can be done about it.

21-80. **Centralized Lubrication.** A. J. Jennings. *Institute Spokesman,* v. 10, Sept. '46, p. 1-5.

Large lubrication systems suitable for steel mill equipment and, at the other extreme, a suitable system for small machinery. Factors for determining pipe sizes for proper distribution without excessive pressures are given for large and small systems.

21-81. **Characteristics of Aluminum Bearings.** Norman E. Woldman. *Iron Age,* v. 158, Sept. 12, '46, p. 60-64.

Physical and operating characteristics of aluminum-base bearing alloys, both American and European types, discussed from the application viewpoint. Comparison is made with other standard type bearing materials; advantages and disadvantages of the various aluminum alloys for specific uses.

21-82. **The Pressures Against Which Oils Will Spread on Solids.** E. Roger Washburn and Elmer A. Anderson. *Journal of Physical Chemistry,* v. 50, Sept. '46, p. 401-412.

Direct experimental method of estimating the relative tendencies of different oils to spread on a polished steel surface. Representative values for lubricating oils in different degrees of oxidation are given and compared with the tendencies of the same oils to spread on water.

21-83. **Reclamation of Precision Babbitt Bearings by the Gas Flame Method.** R. A. McCarthy. *Iron and Steel Engineer,* v. 23, Sept. '46, p. 115-116.

Method makes use of an ordinary welding torch for both the tinning and babbitting operations. Preliminary problems overcome; specific application to rebabbitting of rod mill bearings which are high speed precision bearings in which a steel bushing is lined with a thin liner of cadmium babbitt bearing metal.

21-84. **New Developments in Bearing Metals.** O. W. Ellis. *Canadian Mining and Metallurgical Bulletin,* no. 413, Sept. '46, p. 447-465.

Resistance to abrasion, fatigue, and corrosion; information on testing methods for fatigue and graph of bearing life vs. babbitt thickness. Properties of babbitts, cadmium-base alloys, silver, and aluminum alloys; manufacturing methods.

21-85. **Lubricants.** Ben F. Hunter. *Machine Design,* v. 18, Sept. '46, p. 133-136, 180.

Their proper specification and utilization in design.

21-86. **Multipurpose Paradox.** T. G. Roehner. *Scientific American,* v. 175, Oct. '46, p. 166-168.

Discusses need for greater cooperation among machine designers, bearing builders, grease compounders; further development of multipurpose lubricants for nonmobile equipment; grease application devices with wider adaptability; more about water and high-temperature resistant greases.

21-87. **Symposium—Applied Lubrication.** *Iron and Steel Engineer,* v. 23, Sept. '46, p. 85-99.

Practical application of modern lubricants to modern machinery. Basic principles underlying the science of lubrication, together with a description of typical lubricants supplemented by comments from representatives of builders of the equipment and of the users of the lubricants.

21-88. **Protective Value of Industrial Lubricants.** G. H. von Fuchs. *Iron Age,* v. 158, Oct. '46, p. 46-49.

Vital function of a lubricating oil is to adhere to metal surfaces in such a manner as to exclude moisture and prevent corrosion. Significance of this property and its relationship to the various actions of a good lubricant are analyzed. Testing equipment and procedures. 18 ref.

21-89. **Aluminum Alloys for Bearings.** H. Y. Hunsicker and L. W. Kempf. *S.A.E. Journal.* v. 54, Oct. '46, p. 51-53.

Aluminum-tin alloy bearing life of from 200 to 500% longer than high quality copper-lead, cadmium-base or "micro-babbitt" bearings has been attained in laboratory tests. Some of the data from tests of the Al-Sn-Si-Cu alloy, a tin-base babbitt and a 70 Cu-30 Pb in the Timken lubricant tester are presented. (Presented at S.A.E. Summer Meeting.)

21-90. **What It Takes to Purify Coolants.** B. F. Hunter. *American Machinist,* v. 90, Sept. 26, '46, p. 126-129.

Ideal system for a plant, or a given group of machines, is a centralized system which automatically handles all chips, abrasives and small metal particles with a minimum of manual effort and which will provide clean, cool cutting fluids to the various machines at all times. Suggests layout of such a system. Describes and cites economy of efficient central cutting fluid system for handling soluble oil coolants from 112 grinding machines.

21-91. **Lubricants for Synchronous Unit Bearings.** Jonathan L. Snead and Henry Gisser. *ASTM Bulletin,* no. 141, Aug. '46, p. 45-49.

Tests indicated that a mineral oil having additives for optimum oxidation stability and rust preventive properties was the best of the products studied. Some degree of corrosion protection is required in active service or storage; fatty oils yielding gummy products on oxidation are to be avoided. Tests on a specially prepared grease indicate that grease lubrication may be feasible, but further work is needed.

21-92. **Measurement of Lubricant Film Strength in the Region of Boundary Friction. Part I.** Victor A. Ryan. *Lubrication Engineering,* v. 2, Sept. '46, p. 101-106.

Method for measurement of lubricant film strength in the region of boundary friction has been successfully used for the past five years in the evaluation and specification of oils for the drawing of metal and for cam and roller lubrication under extreme loads. (Presented at spring meeting of the American Society of Lubrication Engineers.)

21-93. **Protective Value of Industrial Lubricants.** B. H. von Fuchs. *Lubrication Engineering,* v. 2, Sept. '46, p. 107-110.

The rust and corrosion preventing properties of oils used primarily as lubricants. Characteristics of lubricants compounded to overcome rusting; steps to be taken in changing over to their use. (Presented at American Society of Lubrication Engineers meeting.)

21-94. **Bibliography of Papers and Books on Lubrication and Related Subjects Published in Germany During the Period 1940 to 1942.** H. Blok. *Lubrication Engineering,* v. 2, Sept. '46, p. 111-113.

135 titles are included.

21-95. **Cutting Fluids in Machining Operations.** L. Massey and A. A. Pollitt. *Metallurgia,* v. 34, Aug. '46, p. 213-218.

Mechanism of cutting; properties desirable in cutting fluids; commercially available cutting fluids. (To be continued.)

21-96. **Forging Costs Cut by Improved Die Lubricant.** Lambert R. Pistoles. *Iron Age,* v. 158, Oct. 17, '46, p. 55-56.

Very low viscosity, volatile oil with a small percentage of a colloidal additive serving as the vehicle for suspending the graphite and aiding in its dispersion on the tools and the forging blank showed better distribution capacity of the graphite around the dies and punches, and it was found necessary to use only one-fourth of the quantity previously used.

21-97. **Aluminum Alloy Bearings for Heavy-Duty Applications.** H. R. Clauser. *Materials & Methods,* v. 24, Sept. '46, p. 633-636.

Development work and experiments with aluminum alloy bearings being conducted by many companies, both metal and bearing manufacturers, all over the country.

21-98. **Prelubrication Cuts Maintenance Costs.** E. N. Fabrizio. *Machine Tool Blue Book,* v. 42, Oct. '46, p. 183-184, 186-187, 188.

Chief advantages of the new presealed bearing, aside from the sharp reduction in maintenance costs, are: Tightly sealed enclosure reduces oxidation of the grease, promoting longer grease life; grease is kept in and dirt is kept out; proper kind and amount of lubricant promotes longer bearing life.

21-99. **Cutting Fluids in Machining Operations.** L. Massey and A. A. Pollitt. *Metallurgia,* v. 34, Sept. '46, p. 275-278.

Types, properties, applications and examination of cutting fluids.

21-100. **Effectiveness of Cutting Oils. Part I and II.** *American Machinist,* v. 90, Oct. 24, '46, p. 137, 139.

Tables show effectiveness of three cutting oils when threading S.A.E. 3140; how sulphur content in oils affects threading S.A.E. 3140 and S.A.E. 1020; effects produced by adding sulphur and chlorine to sulphurized mineral oil; how chlorine affects blended oil; results obtained when lard oil, sulphurized fat and a special oiliness agent are used; chlorine does not improve cutting oils when tapping and threading S.A.E. 1020, and chlorine improves tool life when drilling N.E. 8640 (265 Brinell) at 75 surface ft. per min.

21-101. **Bearing Metals.** E. Wood. *Metal Industry,* v. 69, Oct. 4, '46, p. 277-280.

Why and how bearing metals work; the fundamental advantages of soft metals for bearings; why harder metals should not be considered as true bearing metals at all.

21-102. **Oilless Bearings and the Industrial Press.** Joseph G. Cowley. *Modern Industrial Press,* v. 8, Oct. '46, p. 22-24, 26, 46.

Development of oilless bearings from those made of wood, through graphite oilless, bronze, and finally iron powder. Advantages of latter and some details of their production.

21-103. **Bearings.** P. Martinet. *Materials & Methods,* v. 24, Oct. '46, p. 970.

Brief account of development of Micheline 136. Bearing operation is affected by specific pressure, speed and diameter of the shaft, play in the bearing, viscosity of the oil film, surface finish of the shaft and bearing, nature of the metals, L/D ratio and the oiliness of the lubricant. Three conditions govern the functioning during periods of normal or perfect lubrication: pressure, speed, and viscosity of the oil. The other factors affect mainly the boundaries of this normal period. Various empirical equations are given for determining these relationships. Calculated results are only approximate, since many secondary factors are not taken into consideration. (Condensed from *Mecanique,* v. 30, Feb. '46, p. 45-52.)

21-104. **Machining of Plain Bearings With Single-Point Tools. Part 3. Bearing Characteristics.** *Petroleum,* v. 9, Nov. '46, p. 269.

Data concerning the properties of bearings machined in different ways. 22 ref. (Final installment.)

21-105. **Aluminum Bearings for Caterpillar Engines.** George B. Grim. *Automotive and Aviation Industries,* v. 95, Nov. 1, '46, p. 28-29, 86.

Brief account of investigations carried out by Caterpillar Tractor to determine relative merits of various materials and several available bearing metal combinations under various conditions of load, temperature, and oil condition.

21-106. **Metallic Bearings.** H. L. Smith. *Iron and Steel Engineer,* v. 23, Nov. '46, p. 73-76.

Extensive and detailed answers to A.I.S.E. questionnaire on bearing design and usage.

21-107. **The Influence of Composition on the Adhesion of Tin-Base Bearing Alloys to Steel.** P. C. Forrester and L. T. Greenfield. *Journal of the Institute of Metals,* v. 73, Oct. '46, p. 91-104.

Investigation made to examine whether a bond equal to, or exceeding, the strength of the white metal is obtainable between all the alloys and basis materials tested in conditions analogous to those of practice, using the range of tin-base alloys in commercial use.

21-108. **Lubricating Hot Strip Mills.** A. F. Brewer and W. H. Mandy. *Steel,* v. 119, Dec. 9, '46, p. 90-93, 154, 156.

Increased speed of hot strip mills currently emphasizes the importance of lubrication under high temperature and water and scale contamination conditions. Proper types of grease and oil for roller bearings, screwdowns, couplings, pinions, gears, coilers and other machinery.

21-109. **Bearing Selection Guided by Relative Material Merits.** R. A. Watson and W. E. Thill. *S.A.E. Journal,* v. 54, Dec. '46, p. 41-46.

Compares the performance of present-day bearing alloys, and offers both engineer and engine operator a practical tool to rational choice of the right bearing for the job.

21-110. **The Strip Steel Mill.** *Lubrication,* v. 32, Sept. '46, p. 101-112.

Problem of lubricating under high temperature, high speed, water and scale-contamination conditions. Pertains particularly to the work roll bearings and backup roll bearings, and indirectly to the screwdown drives, the universal couplings, pinion stands and reduction gears, the table roll bearings and the coiler.

21-111. **How Special Blending Improves Cutting Fluids.** James T. Beard, Jr. *Machinery,* v. 53, Dec. '46, p. 156-160.

Tests prove effectiveness of adding sulphur, chlorine, oiliness agents, and other compounds to cutting fluids for machining various steels.

21-112. **Lubricating Hot Strip Mills.** A. F. Brewer and W. H. Mandy. *Steel,* v. 119, Dec. 16, '46, p. 94-96, 140.

Planning lubricating system.

SECTION XXII

WELDING AND JOINING

Brazing; Flame Cutting; Riveting

22-1. **Arc Welding Permits Field Repairs on Corroded Pressure Vessel.** Frank G. Clark. *National Petroleum News,* v. 37, Dec. 5, '45, pp. R995-R996.

Technique worked out for replacing bottom nozzle in high temperature reaction chamber includes installing stainless steel facing with weld metal, together with method for preheating and stress relieving.

22-2. **Arc Welded Cutting Alloys.** E. C. Rollason and P. Harris. *Engineers' Digest (American Edition),* v. 2, Nov. '45, pp. 571-573.

Use of metallic arc welding as means of facing engineering parts with hard metal and for building up of cutting edges. Special alloys can be produced by employing a mild steel core wire electrode with a heavy metallic coating containing the alloying elements. (From *Metallurgia,* Nov. '44, pp. 3-6.)

22-3. **The Manufacture of Butt-Welded Pipe.** N. W. Richardson. *Iron & Steel Engineer,* v. 22, Nov. '45, pp. 64-68.

Important advantages of Fretz-Moon process are reduced costs of operation and maintenance, high quality and high yield.

22-4. **Torches Pinch-Hit in Machining Operations.** G. V. Slottman. *American Machinist,* v. 89, Dec. 20, '45, pp. 110-112.

Examples of how flame cutting can be used on jobs other than profile cutting of flat plates.

22-5. **Hints for Reduction of Rejects in Spot Welding.** T. A. Beck. *Industry & Welding,* v. 18, Dec. '45, pp. 34-35, 85-86.

Gives fundamentals.

22-6. **Atomic Welding; Agent of Construction.** A. D. Bulaw. *Industry & Welding,* v. 18, Dec. '45, pp. 50-51, 54, 56.

Atomic hydrogen arc welding facilitates use of stainless steel, Monel, and aluminum.

22-7. **Atomic Bomb Development Hastened by Submerged Arc Welding.** A. F. Davis. *Industry & Welding,* v. 18, Dec. '45, pp. 62-64, 104.

Precautions taken; efficiency in fit-up; sealing beads in sequence.

22-8. **Factors in "Underbead Cracking".** S. L. Hoyt, C. E. Sims, and H. M. Banta. *Industry & Welding,* v. 18, Dec. '45, pp. 72, 74, 76-77.

Discusses steel processing methods and shows how their control assists in reducing the hazard of cracking. (Abstracted from *Welding Journal.*)

22-9. **Welding in Temporary Housing.** Leonard W. Elliott. *Welding Engineer,* v. 30, Dec. '45, pp. 35-38.

Three of seven basic types of small prefabricated homes to be built in quantity in Britain during the next two years are to have frames of welded-steel construction.

22-10. **Fabricated Steam Platens.** *Welding Engineer,* v. 30, Dec. '45 p. 39.

Flame cutting and welding help to produce homogeneously bonded platen with a labyrinth in its interior for stream of cooling fluid.

22-11. **Rebuilding High-Speed Cutters.** Joseph A. Cunningham and C. W. F. Sust. *Welding Engineer,* v. 30, Dec. '45, pp. 40-41.

Worn end-milling cutters reclaimed by arc welding and new composite ones made; both lasted several times as long as originals.

22-12. **Economics of Arc Welding, Part II.** Walter J. Brooking. *Welding Engineer,* v. 30, Dec. '45, pp. 42-45.

Discusses use of large-size electrodes; obtaining good fit-ups; keeping down size of welds; obtaining effective use of operator's time.

22-13. **Flame Cutting Battered Rails.** G. Johnson. *Welding Engineer,* v. 30, Dec. '45, pp. 46-47.

Portable flame cutting machine used to trim rails flat without any grinding.

22-14. **Big Jobs From Iron Horses.** T. B. Jefferson. *Welding Engineer,* v. 30, Dec. '45, p. 49.

Welding of broken locomotive cylinders.

22-15. **Welding Big Condenser Flanges.** Joseph S. Wright. *Welding Engineer,* v. 30, Dec. '45, p. 54.

Proper technique for welding large condenser flanges to secure a finished job without warpage.

22-16. **Fabrication of Aircraft Fuel Tanks in Aluminum Alloy Containing 3% Magnesium.** W. K. B. Marshall. *Transactions of the Institute of Welding,* v. 8, Nov. '45, pp. 134-143.

Various stages in successful solution of problem. 8 ref.

22-17. **Modern Fabrication Practice.** W. A. Roy and I. H. Hogg. *Transactions of the Institute of Welding,* v. 8, Nov. '45, pp. 144-150.

Deals with engine mountings. Design and construction of gun mountings and armor gun-shields, with some notes on manipulators and flash-butt welding.

22-18. **Under-Water Arc Welding.** W. N. Kemp. *Transactions of the Institute of Welding,* v. 8, Nov. '45, pp. 152-156.

Reviews types of equipment, techniques and current settings suitable for under-water welding, and metallurgical and mechanical properties of welds.

22-19. **Pressure Welding of Light Alloys Without Fusion.** R. F. Tylecote. *Transactions of the Institute of Welding,* v. 8, Nov. '45, pp. 163-178.

Describes results of attempts to weld overlapping sheets of nine aluminum and three magnesium alloys by simultaneous application of heat and pressure at temperatures below their melting points. It was found possible to weld all alloys to a greater or lesser degree. An aluminum alloy containing magnesium and silicon in the proportions to give Mg_2Si, a duralumin type alloy and an aluminum alloy containing 1¼% manganese, were found to give best results. Stresses importance of effective cleaning of surfaces. Although recrystallization occurred across the interface in many cases it cannot be said that microscopically visible recrystallization is a necessary condition for successful welding. 16 ref.

22-20. **Weldability Factors for 18-8 Stainless.** Franklin H. Page. *Iron Age,* v. 156, Dec. 27, '45, pp. 58-61.

Discusses effects of slight variations in the percentages of silicon, manganese, and other elements. By decreasing the percentage of steels with a low weldability index through slight changes in chemical composition within existing specifications, welding costs may be materially reduced.

22-21. **The Spot Welding of Heavy Gage Aluminum Coated Duralumin.** H. E. Dixon. *Welding,* v. 13, Dec. '45, pp. 486-498.

Heavy gage light alloy sheets present particular spot welding problems. Discusses results obtained from British and American equipment. Data relating to weld quality as affected by various factors given; also recommendations for suitable welding technique. 6 ref.

22-22. **Magnesium Alloy Sheet and Tube and Its Fabrication by Oxy-Acetylene Welding.** E. Ryalls. *Welding,* v. 13, Dec. '45, pp. 499-508, 533.

Weldability of magnesium alloys, weld design, joint preparation and welding technique. Examples included of this type of fabrication, with special reference to aircraft industry. Best methods of overcoming various problems explained in detail.

22-23. **Merton Portable Hangar.** *Welding,* v. 13, Dec. '45, pp. 509-515.

Secrets of the construction and design of portable hangars disclosed. How welding made possible their production in large numbers. Both arc and gas welding extensively used.

22-24. **Welding Chromium-Nickel Steels.** *Welding,* v. 13, Dec. '45, pp. 520-524.

Details given of metallurgical factors involved in the welding of chromium-nickel steels. Columbium and titanium-stabilized types also considered and review of desirable welding rod compositions given.

22-25. **Electric Arc-Welding Standards.** *Steel,* v. 117, Dec. 31, '45, pp. 75-76.

Both machines and electrodes included. Also covers small alternating-current welders.

22-26. **Copper Furnace Brazing.** Glen A. Robinson. *Machinery,* v. 52, Dec. '45, pp. 139-146.
Reviews equipment and methods now being applied in large-scale industrial operations.

22-27. **Brazing Tool Tips to Shanks by Induction Heating.** T. A. Vernor and E. F. Adams. *Machinery,* v. 52, Dec. '45, pp. 178-179.
Brazes alloy tool tips to single-point tools in a fraction of time required by methods formerly employed.

22-28. **Precision Oxy-Acetylene Cutting.** F. G. Kerry. *Canadian Metals & Metallurgical Industries,* v. 8, Dec. '45, pp. 34-37, 46-47.
Accurate methods influence fabrication and speed production. Cites advantages.

22-29. **Combining Metal Forms Simplifies Production.** R. J. Wolf. *Materials & Methods,* v. 22, Dec. '45, pp. 1739-1743.
Cost, design and manufacture all benefit when weldments combine rolled sections, castings, stampings and forgings.

22-30. **Lead Base Solders and Babbitts.** Robert S. Burpo. *Materials & Methods,* v. 22, Dec. '45, p. 1781.
Name; composition, per cent; Brinell hardness (of babbitts); and commercial specifications.

22-31. **Safe Practice in Oxy-Acetylene Welding.** Don Attaway. *Petroleum Refiner,* v. 24, Dec. '45, pp. 105-108.
Safe practices most generally accepted for oxy-acetylene operation of cutting and welding accumulated from most reliable sources, such as experience of safety engineers, welding foremen, construction engineers and experienced operators.

22-32. **The Aluminum Dip Brazing Process.** C. L. Bensen and R. N. Weber. *Aluminum & Magnesium,* v. 2, Dec. '45, pp. 14-17.
Gives experience at McQuary, Inc., on widely separated types of products. Includes the bonding of almost any relatively light gage aluminum assembly.

22-33. **Processing of Magnesium Alloys.** N. H. Simpson. *Aluminum & Magnesium,* v. 2, Dec. '45, pp. 18-22, 36-38.
Riveting; bolting; welding; spot welding. 5 ref.

22-34. **Electronic Bloodhound Guides Cutting Torches Accurately.** G. V. Slottman. *American Machinist,* v. 90, Jan. 3, '46, pp. 94-96.
Beam follows complex shapes on inexpensive paper templets and thus directs torches in cutting steel parts to close dimensions. Eliminates metal and wood templets and all other mechanical or manual auxiliary guiding devices.

22-35. **Weld Metal.** L. Reeve. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 560-563.
Relation between hydrogen content and oxygen content.

22-36. **Arc-Weld Deposits.** H. A. Sloman, T. E. Rooney and T. H. Schofield. *Iron and Steel,* v. 18, Nov. 30, '45, pp. 606-613.
Preliminary investigation of their constitution.

22-37. **Spot and Seam Welding Aluminum. Part 4.** O. A. Perry. *Light Metal Age,* v. 3, Dec. '45, pp. 15-18, 34.

Contains valuable recommendations regarding tooling and production methods. Primary considerations, tooling analysis, shop orders, fixtures, Cleco assemblies, and special tooling. Recommendations are made as to location and layout of a spot welding department, centralization of equipment, and proper supervisory methods for an efficient and practical department.

22-38. **The Welding of Non-Ferrous Metals, Part VII.** E. G. West. *Sheet Metal Industries,* v. 22, Dec. '45, pp. 2167-2174.

Gas and metallic arc welding of aluminum and its alloys.

22-39. **Power Factor Correction of A.C. Resistance Welding Machines by Means of Series Condensers.** G. B. Higgins. *Sheet Metal Industries,* v. 22, Dec. '45, pp. 2175-2181.

Shunt condensers; series condensers; adding power factor correction; use with program control; electronic control circuits; discharging the series condenser; characteristics of power factor corrected machines. 5 ref.

22-40. **Electronic Tracing Device.** *Steel,* v. 118, Jan. 14, '46, pp. 94, 128.

Control of cutting torch is absolute with "electric eye" which follows outline of drawn patterns, thus eliminating metal and wood templates and other mechanical or auxiliary guiding devices formerly used.

22-41. **Flame Cutting.** James F. Smythe. *Steel,* v. 118, Jan. 14, '46, pp. 104, 131.

Technique devised to eliminate machining in semi-finishing breechblocks suggests economies to be obtained in peacetime production.

22-42. **High-Quality Tank Manufacture.** William P. Hindman. *Machinery,* v. 52, Jan. '46, pp. 135-142.

Large tanks for the transportation and storage of hazardous and non-hazardous liquids and gases are manufactured on a production basis by a technique that has practically eliminated even minute welding flaws.

22-43. **Comparative Study of Electric and Gas-Air Methods of Silver Brazing.** Paul F. Berg. *Machinery,* v. 52, Jan. '46, pp. 151-154.

Discusses briefly advances and their applications, and compares open-flame gas-air operations with induction heating in so far as shop practice and equipment selection are concerned.

22-44. **Gas-Shielded Arc Welding of Aluminum.** A. F. Leach. *Welding Journal,* v. 24, Dec. '45, p. 1129-1134.

Atomic hydrogen arc process best used in applications where flux can be tolerated, where high welding speed is desirable, where joints are not in cramped quarters so that the double tungsten electrode holder can be used, and where fixed arc length can be maintained for automatic welding. Helium-shielded arc best suited where flux can be tolerated, where joints are in close quarters requiring the small single tungsten electrode holder and where automatic welding is to be used on joints with uneven contours. Since flux is not used in argon-shielded arc proc-

ess, all manner of joints can be successfully made with no danger of subsequent corrosion.

22-45. **Work of the Mobile Ordnance Repair Shops.** Samuel G. Dunlap. *Welding Journal,* v. 24, Dec. '45, p. 1139-1141.

Organization, equipment, mission, and types of work performed by mobile Ordnance maintenance organizations. Ordnance Department develops, tests, procures, stores, distributes, and maintains in serviceable condition automotive equipment and combat vehicles, weapons, fire control instruments, and ammunition.

22-46. **Metallurgy as Applied to Welding.** R. B. Lincoln. *Welding Journal,* v. 24, Dec. '45, p. 1143-1147.

An effort is made to present such items as 25 years of contact with welding problems suggest as most useful to welders, inspectors and foremen.

22-47. **Binding Agents for Flux Coatings, Their Composition and Production.** W. Andrews. *Welding Journal,* v. 24, Dec. '45, p. 1147-1154.

Alkaline silicates; drying of silicates; effect of moisture in electrode fluxes; welding of aluminum; use of sodium aluminates; fluorides; aluminate coatings; the mixing operation; the mixing equipment; theory of binding action; mechanism of drying; high plasticity; physical reactions in fusion; fluoride-bound coatings; practical manipulation; preparation for direct mixing; application of a chemical test; quality of the flux paste; future research problems. 14 ref.

22-48. **Modern Hard Facing Methods, Parts I and II.** A. R. Lytle. *Welding Journal,* v. 24, Dec. '45, p. 1155-1165.

Several methods of mechanization useful with several types of hard facing alloys. One new method of hard facing promises to be especially suitable for the intermittent type of surface or where only the very hard tungsten carbide granules are serviceable. A new surfacing alloy is applicable by either electric arc or flame welding with unique properties of machinability and excellent endurance for hot die work and similar alloys for surfacing parts subjected to severe corrosion.

22-49. **Adams Lecture—Selection of Steel for Welding.** S. L. Hoyt. *Welding Journal,* v. 24, Dec. '45, p. 1180-1187.

Interdependence of fabricator, user and steel manufacturer is emphasized. Importance of the property of steel known as "cohesiveness" and its application to welding.

22-50. **The Quantitative Measurement of Welding Response by Bead Welds.** R. D. Stout, S. S. Tör and G. E. Doan. *Welding Journal,* v. 24, Dec. '45, p. 625s-628s.

A direct method for measuring response by making simple bead-on-plate welds. Direct method avoids several deficiencies of the Jominy method such as are found in steels of low hardenability, of high alloy content, of irregular carbide size or solubility and in plates less than 1 in. thick. It also makes unnecessary a high temperature (2100° F.) furnace. Direct welding tests do not require the use of an automatic welding machine. Self-consuming electrode method has been found entirely dependable. 3 ref.

22-51. **An Investigation of the Spot Welding of Aluminum Alloys Using Magnetic Energy Storage Equipment Provided by the Sciaky Brothers.** W. F. Hess, R. A. Wyant and B. L. Averbach. *Welding Journal,* v. 24, Dec. '45, p. 629s-643s.

Comparative study of three different types of welding equipment offered for the spot welding of aluminum alloys for aircraft structures. Three types are: conventional a. c. equipment, the condenser-discharge equipment and the magnetic energy storage equipment—experiences and results with the latter being described in this section. 6 ref.

22-52. **Spot Welding of Heavier Gages of Aluminum Alloy. Part III—The Spot Welding of Wire-Brushed 24S-T Alclad Aluminum Alloy Sheets in Thicknesses From 0.081 to 0.125 In., Inclusive.** *Welding Journal,* v. 24, Dec. '45, p. 652s-667s.

Spot welding 24S-T alclad sheets of 0.081, 0.091, 0.102 and 0.125 in. thickness. Investigation was carried out with a press type condenser discharge aluminum spot welder with a maximum capacitance of 7500 μf and a maximum tip force of 9000 lb. Curves and data show influence of welding machine variables upon weld strength, geometry and quality. Optimum welding techniques are indicated for the listed gages.

22-53. **Spot Welding of Heavier Gages of Aluminum Alloy. Part II—New Portable Instruments for Rapid Measurement of Current and Tip Force in Spot-Welding Machines.** R. C. McMaster and N. A. Begovich. *Welding Journal,* v. 24, Dec. '45, p. 664s-652s.

Details of design, construction, calibration and method of using a new portable instrument for measuring welding current and tip force in spot welding machines. Current and tip force are measured by means of a small unit combining a toroid and a strain gage bridge. Unit may be slipped over the electrode holder of any spot welder and clamped ready for use in a few minutes. Simultaneous records of welding current and tip force obtained with this unit may be applied to either a cathode ray or magnetic oscillograph or both. 3 ref.

22-54. **The Spot Welding of Dissimilar Thicknesses of Alclad 24S-T.** W. F. Hess, R. A. Wyant and B. L. Averbach. *Welding Journal,* v. 24, Dec. '45, p. 667s-672s.

Some preliminary work on the spot welding of 0.020, 0.040, 0.020 to 0.064, and 0.020 to 0.125-in. Alclad 24S-T and methods of leaving either the thick or the thin sheet smooth.

22-55. **Friction Welding of Thermoplastics.** Kenneth Rose. *Materials and Methods,* v. 22, Dec. '45, p. 1728-1730.

New method developed to bond plastics can be used to join plastics with other materials, including metals.

22-56. **Introduction to the Theory of Lock Nuts.** H. S. Rowell. *Engineering,* v. 160, Dec. 7, '45, p. 464.

Positive locking devices and lock washers; reasons lock nuts are needed.

22-57. **Blind Riveting in Assembly Work.** Lucien Virgile. *Aero Digest,* v. 52, Jan. '46, p. 66, 106.

Essential in places where inaccessibility or space restric-

tions prevent the use of a bucking bar, thus making impossible the installation of ordinary rivets. Widely used for convenience and time saving involved in applications where strength is not critical; also used extensively for field repairs. Brief classification and description of the various types of bind rivets.

22-58. **Economics of Arc Welding.** Walter J. Brooking. *Steel,* v. 118, Jan. 21, '46, p. 80-81, 111-112.

Economic latitudes permissible in design, use of material, setting up fixtures, and weld deposition.

22-59. **Non-Gassing Ferrosilicon for Welding Electrode Coatings.** B. E. Cass and G. A. Ostrom. *Foote Prints,* v. 17, no. 2, '45, p. 9-17.

A new treatment for producing non-gassing ferrosilicon has been developed, and comprehensive tests indicate that it has minimal gas-forming propensities when used as an ingredient of welding electrode coating mixtures.

22-60. **The Welding of Nickel Alloy Steels.** T. N. Armstrong. *Iron Age,* v. 157, Jan. 24, '46, p. 36-41.

Factors influencing weldability and hardenability with respect to welding by the metal-arc process.

22-61. **Explorers Under the Earth.** Fred M. Burt. *Welding Engineer,* v. 31, Jan. '46, p. 38-41.

Tools to drill oil wells have to be rugged as they take a terrific beating. Hard-facing is a necessity for the cutters of core drills, which are required to plumb the earth to depths of three miles.

22-62. **Elements of Welded Design. Part I.** George L. Snyder. *Welding Engineer,* v. 31, Jan. '46, p. 42-46.

Flame cutting vs. shearing, bending and other forming operations, preweld machining, etc., for welded machinery frames.

22-63. **Postwar Resistance Welding.** J. W. Kehoe and I. A. Crawford. *Welding Engineer,* v. 31, Jan. '46, p. 48-51.

Planning for postwar uses; considerations prior to design; application and activity; materials and preparation; choosing the R-W process; small and large parts; equipment and power; tools and fixtures; recording information.

22-64. **That Versatile Stud Welder.** Clyde B. Clason. *Welding Engineer,* v. 31, Jan. '46, p. 52-55.

Electric arc stud welding process has a host of uses and is applicable to any industry where metal studs or pins must be end-welded to metal surfaces.

22-65. **Electronic Tracing Widens Scope of Flame Cutting.** Walter Bergerow. *Welding Engineer,* v. 31, Jan. '46, p. 56-60.

Electronically controlled flame cutting is flexible, accurate and economical. Ease of template preparation (the template is simply a drawing) opens up a way to cut complex shapes which formerly couldn't be handled. (Abstract of a paper for American Welding Society.)

22-66. **Welding, Joining, Fastening.** T. C. Du Mond. *Materials and Methods,* v. 23, Jan. '46, p. 135-139.

Multiple arc welding; inert gas shielded welding; stor-

age battery welding; brazing; mechanical fastening; rolled threads; continued research.

22-67. **The Welding of Nickel Alloy Steels. Part II.** T. N. Armstrong. *Iron Age,* v. 157, Jan. 31, '46, p. 49-55.

Various tests, supplemented with data, which are used as a means of evaluating steels for metal arc welding. Results obtained from physical tests conducted in the selection of welding electrodes.

22-68. **New N.E.M.A. Electric Arc Welding Machine and Electrode Standards.** *Industry and Welding,* v. 19, Jan. '46, p. 42-45.

A.c. and d.c. machines now rated on basis of same duty-cycles. New standards for limited input transformer arc welder (for rural areas) are now developed.

22-69. **Fabrication by Modern Methods in Dipper Construction.** Earle S. Lee. *Industry and Welding,* v. 19, Jan. '46, p. 56-57.

Entire assembly, with the exception of the manganese steel parts, is constructed of high tensile steel plate stock. Entire assembly was tack-welded, with all parts in the correct location. Weight of completed dipper, with riveted parts assembled, was 33,000 lb. Height was 7 ft., 3 in., width 8 ft., 9 in. Seven hundred pounds of welding electrodes were required to complete the welding operations on one dipper.

22-70. **Common Sense in Welding Fundamentals, II.** W. J. Conley. *Industry and Welding,* v. 19, Jan. '46, p. 46-47, 88-90.

Metal and alloy specifications; mechanical properties of steels; grouping of properties; densities and specific gravities.

22-71. **Metallizing in Welding Fabrication.** Walter J. Brooking. *Canadian Metals and Metallurgical Industries,* v. 9, Jan. '46, p. 14-18, 24.

Methods and economics of application in maintenance, repair and salvage.

22-72. **Economics of Arc Welding, Part II.** Walter J. Brooking. *Steel,* v. 118, Jan. 28, '46, p. 124-126, 187-189.

Four additional factors are analyzed for their effect on total cost of welded product.

22-73. **Silver Alloys Braze Auto Parts.** Adolph Bregman. *American Machinist,* v. 90, Jan. 31, '46, p. 82-83.

High strength joints brazed to meet wartime mobile-equipment requirements suggest increased automotive use of silver alloys.

22-74. **Flame Cutting Steel Under Water.** G. V. Slottman. *American Machinist,* v. 90, Jan. 31, '46, p. 110-113.

Origins and wartime development of techniques for cutting with oxy-acetylene, oxy-hydrogen and electric arc

22-75. **Brazing and Heat Treating Assemblies for Magni-Lastic Expansion Joints.** *Industrial Heating,* v. 13, Jan. '46, p. 38, 40, 42, 44, 92, 94.

Joints can be furnished micron-tight for vacuum service, and are capable of withstanding 0 to 55 psi. internal

pressure. May be used at temperatures between 300 and 900° F., and, by selection of proper metal for construction of bellows that give the joints their ability to flex, can be used in systems handling corrosive gases or liquids. Outlines method of bellows fabrication that allows use of spring-tempered metal, in which a series of diaphragms are joined alternately at their inner and outer peripheries. Diaphragms are lock seamed and the joints are either soldered, welded or brazed, depending upon the application.

22-76. **Silver Brazing With Gas Heating.** *Western Machinery and Steel World,* v. 37, Jan. '46, p. 28-29.

Silver brazing with gas-air ceramic burners is a fast, inexpensive and continuous method of joining metals, and is flexible and adaptable enough to be used on both large and small production jobs. Techniques and equipment for this method of production-line joining discussed.

22-77. **High Speed Welder Control.** *Steel,* v. 118, Feb. 4, '46, p. 118, 178, 180.

Large number of joints made in one operation with aid of control permitting automatic assembly welding rates up to 900 spots per minute.

22-78. **40-Foot 1,000,000-Amp. Butt Weld.** *Steel,* v. 118, Feb. 4, '46, p. 120-123, 158, 160.

Permits mass production of large diameter pipe by special forming-welding-sizing process.

22-79. **Scrap-Handling Magnet Improved Through Welded Design.** *Steel,* v. 118, Feb. 4, '46, p. 134, 136.

Pole shoes are solid welded rings of metal offering increased strength and greater resistance to wear. All-welded construction permits sealing the magnet against moisture-entrance and insures a permanent contact between pole shoes and magnet-housing.

22-80. **Trends in Metals Joining.** V. H. Laughner. *Steel Processing,* v. 32, Jan. '46, p. 35-38, 42.

Arc welding; brazing; resistance welding.

22-81. **Measurement and Effect of Contact Resistance in Spot Welding.** Robert A. Wyant. *Electrical Engineering,* v. 65, Jan. '46, p. 26-33.

Contact resistance and the spot welding of aluminum alloys; development of chemical methods of surface treatment; contact resistance and the spot welding of other metals. 15 ref.

22-82. **Arc Welding Trends in Wartime Germany.** F. W. Myers. *Iron Age,* v. 157, Feb. 7, '46, p. 56-60.

Personnel problems; German research projects; welded railroad equipment.

22-83. **The Welding of Nickel-Alloy Steels, Part III.** T. N. Armstrong. *Iron Age,* v. 157, Feb. 7, '46, p. 69-76.

Intricacies of structural welding and the fabrication of pressure vessels by welding, and test data governing selection of steels for these purposes. Fatigue strength of arc welded joints also considered.

22-84. **Draw up Those Flange Bolts More Uniformly.** Laurence H. Carr. *Power,* v. 90, Feb. '46, p. 68-70.

Importance of proper tightening to produce a successful flanged joint below. Suggests methods of checking each bolt's loading.

22-85. **Welded Jigs and Fixtures.** R. P. Sharer. *Machine Tool Blue Book,* v. 42, Feb. '46, p. 213-214, 216, 218.

With this method of joining metals, all types of structures can be assembled "to order" with a minimum of time and at much lower costs. Cites several instances.

22-86. **Acetylene Proves Economical in Flame Cutting Steel.** G. V. Slottman. *American Machinist,* v. 90, Feb. 14, '46, p. 134-135.

Fast rate of heating and low oxygen-gas ratio show savings for acetylene not reflected on a Btu. basis.

22-87. **Production Brazing Developments.** N. K. *Machinery (London),* v. 68, Jan. 17, '46, p. 77-84.

Modern brazing alloys; principles of design and procedure; depth of lap; type of flux and method of heating; production brazing.

22-88. **Pressure Welding.** *Metal Industry,* v. 68, Jan. 18, '46, p. 54.

Joining light alloys without fusion.

22-89. **A Guide for Cutting Small Circles.** *Oxy-Acetylene Tips,* v. 15, Jan. '46, p. 10.

Assembly of the guide and operation.

22-90. **Bronze-Surfacing Worn Pump Impellers.** *Oxy-Acetylene Tips,* v. 15, Jan. '46, p. 12.

Templet saved rod, gases, and time on this bronze-surfacing job.

22-91. **An Easily Made Pipe-Cutting Machine.** *Oxy-Acetylene Tips,* v. 15, Jan. '46, p. 15.

Steel pipe of any wall thickness and a wide range of sizes can be cut with a high degree of accuracy by means of a pipe-cutting machine that can be made in the average shop; can be driven either by hand or electrically, and fabricated at low cost from materials easily obtainable.

22-92. **Welded Equipment for the School Shop.** *Oxy-Acetylene Tips,* v. 15, Jan. '46, p. 16-17.

Durable and convenient tool racks that are easily made.

22-93. **It Pays to Use Good Hard Facing Rods.** *Oxy-Acetylene Tips,* v. 15, Jan. '46, p. 18-20.

High-quality surfacing alloys reduce down time and actually cost less.

22-94. **Advanced Fastening System.** *Steel,* v. 118, Feb. 11, '46, p. 92-95, 140, 142, 144, 146, 149.

Simple spring steel shapes combine thread lock with spring lock, affording unusually fast and effective method of assembling sheet metal, porcelain, glass and plastic parts; over 3000 different modifications of basic idea adapt system to exceptionally wide range of applications.

22-95. **Bailey Bridge Production.** C. A. Kershaw. *Welding,* v. 14, Jan. '46, p. 2-11.

Welding methods and control procedures.

22-96. **Butt Welding of Heavy Sections—an Application of the Submerged Arc Process.** Richard R. Sillifant. *Welding,* v. 14, Jan. '46, p. 12-25.

Tests carried out to determine the best conditions for the automatic arc welding by the Unionmelt process of plate up to 6 in. thick. Results will enable designers of pressure vessels to employ thicker material. Properties of the welds made are given.

22-97. **Welding in Shipbuilding.** D. M. Kerr. *Welding,* v. 14, Jan. '46, p. 26-39.

Improvements in design and practice, especially with reference to the construction of prefabricated units. (Abstract of paper for Institute of Welding.)

22-98. **Unusual Flame Cutting.** *Welding,* v. 14, Jan. '46, p. 40-42.

Tests on steel 44 in. and 54 in. thick.

22-99. **Metallurgical Aspects of High Quality Pressure Welded Joints for Landing Gear. Part I. Influence of Oxygen.** Leslie Fine, Charles H. Maak and Anthony R. Ozanich. *Metal Progress,* v. 49, Feb. '46, p. 350-355.

Process found particularly well suited for landing gear because consistently high quality joints can be made. Parts difficult or impractical to forge and machine in one piece can be fabricated from simple sub-assemblies into one unit possessing physical properties equal to an equivalent part made in one piece. A new concept of the mechanism of oxygen diffusion in steel is applied to uniwelding. Microscopic evaluation of uniwelds, as revealed by the alkaline chromate etch.

22-100. **Welding of Nickel Alloy Steels.** T. N. Armstrong. *Iron Age,* v. 157, Feb. 14, '46, p. 56-60.

Spot welding, upset butt welding, forge welding, oxy-acetylene welding and oxy-acetylene pressure welding.

22-101. **Testing the Effectiveness of Self-Locking Nuts.** J. A. Sauer. *Product Engineering,* v. 17, Feb. '46, p. 97-100.

Four simple tests whereby the effectiveness of self-locking nuts and other fastening devices can be determined. Equipment for carrying out the tests and number of samples needed to give a satisfactory measure of performance.

22-102. **Hard-Facing Materials to Improve Product Performance.** A. T. Cape. *Product Engineering,* v. 17, Feb. '46, p. 134-137.

Selection, composition, treatment and properties of hard facing materials, together with a number of case histories which illustrate the possibilities of these new overlays for improving performance, life and cost of products.

22-103. **The Design and Methods of Construction of Weld Steel Merchant Vessels.** *Welding Journal,* v. 25, Jan. '46, p. 5-18.

Abstract of Second Interim Report of a Board of Investigation convened by order of the Secretary of the Navy.

22-104. **The Steel Warehouse and Flame Cutting.** Leonard J. Quetsch. *Welding Journal,* v. 25, Jan. '46, p. 24-25.

Examples of flame cutting showing combination of flame cutting, forming and welding. The others are simply flame-cut pieces, but demonstrate what can be procured from average steel warehouse operating a flame cutting department.

22-105. **Induction Heating Brazes Tool Tips.** T. A. Vernor and E. F. Adams. *Welding Journal,* v. 25, Jan. '46, p. 26.

Brazes alloy tool tips onto single point tools in a fraction of the time formerly required with acetylene gas torches.

22-106. **The Application of Pressure Welding to Overland Pipe Lines.** E. P. Jones. *Welding Journal,* v. 25, Jan. '46, p. 27-31.

History and development of equipment, and technique for adapting this oxy-acetylene process to pipe-line right-of-way conditions.

22-107. **Welded Design as Applied to Light Weight Army and Navy Structures.** H. A. Oldenkamp. *Welding Journal,* v. 25, Jan. '46, p. 33-37.

Advantages and disadvantages; comparison with other kinds of fabrication; description of some of the equipment which was produced.

22-108. **Resistance Welding on Stainless Steel Aircraft Engines and Accessories.** Frank G. Harkins and W. L. Hales. *Welding Journal,* v. 25, Jan. '46, p. 39-46.

Parts illustrated include components of manifolds, heat exchangers, cowling, jet engines and sundry others used in modern airplanes, military and commercial, with comments on performances of various operations.

22-109. **Alternating and Direct Current Welding.** Lee Cline. *Welding Journal,* v. 25, Jan. '46, p. 51-52.

Tests show saving of approximately $150 per year when using alternating current. Maintenance cost on a.c. equipment approximately 10% of what it is on d.c. equipment. Over a two-year period of operation saving in power and maintenance cost would pay for a 500-amp. a.c. transformer.

22-110. **The Flash Welding of Alclad 24S-T Alloy in the 0.064-In. Thickness.** W. F. Hess and F. J. Winsor. *Welding Journal,* v. 25, Jan. '46, p. 9s-20s.

Result of preliminary investigation of the flash welding of aluminum alloys made with Alclad 24S-T alloy in the 0.064-in. thickness. 2 ref.

22-111. **An Investigation of Current Wave-Form for Spot Welding Alclad 24S-T, 0.020 In. in Thickness.** W. F. Hess, R. A. Wyant and B. L. Averbach. *Welding Journal,* v. 25, Jan. '46, p. 20s-29s.

Two wave-forms investigated in which the welding was limited to 0.020-in. Alclad 24S-T. Important difference between the two wave-forms was in the rate of current rise and the length of time during which the current was near its peak value. Two methods of surface treatment studied. One consisted of wire brushing and the other of chemically treating to produce the desired surface resistance and at the same time retain the bright mill finish. 4 ref.

22-112. **High Speed Spot Welding.** Bernard Gross. *Iron Age,* v. 157, Feb. 21, '46, p. 52-55.

Some of the factors which must receive careful attention to assure successful high speed production, including machine design, tooling, setup, maintenance, and personnel training.

22-113. **Welding Machine Speeds Refrigerator Manufacture.** Cyril C. Peck. *Iron Age,* v. 157, Feb. 21, '46, p. 62-63.

Unit measures 9½ in. in both diameter and height, and consists of two cup-shaped members fitted together and automatically welded around the circumferential seam to render the structure absolutely leakproof.

22-114. **Hinges Fabricated by Welding.** C. H. Buckmaster. *Iron Age,* v. 157, Feb. 21, '46, p. 64.

Welding process effects a reduction of about 50% in cost as compared to production by the former cast design; the setup should lend itself readily to the fabrication of numerous automotive and machinery parts.

22-115. **How to Apply Corrosion Resistant Loose Liners to Steel Vessels.** *Industry and Welding,* v. 19, Feb. '46, p. 52-56.

When clad steel is used; when loose linings are used; what thickness to use; a change-over job; types of linings for nozzles.

22-116. **Custom-Made Fixtures for the Submerged Arc Welding Process.** Cecil C. Peck. *Industry and Welding,* v. 19, Feb. '46, p. 80-81, 94-97.

Special automatically operated fixtures make submerged arc welding possible; speed in welding and handling operations increased to a production rate of one completely welded compressor unit per minute.

22-117. **Fabricated-Welded Valves.** Ernest Califro. *Welding Engineer,* v. 31, Feb. '46, p. 35-38.

Welding as a means of fabricating gate valves, globe valves and swing check valves. Offers two important advantages: The cost of expensive patterns is eliminated and the finished product may be obtained in a much shorter period of time.

22-118. **Welded Shaft Mounting.** *Welding Engineer,* v. 31, Feb. '46, p. 39.

Cost saving of about 45% and a weight saving of 23% effected by turning to welded fabrication for the power shaft mounting of an engine-driven scythe.

22-119. **Heat for Silver Brazing.** Paul F. Berg. *Welding Engineer,* v. 31, Feb. '46, p. 44-46.

Costs of new gas-air burners compare favorably with induction heaters.

22-120. **Flash Welding for Jet Propulsion.** *Welding Engineer,* v. 31, Feb. '46, p. 54-55.

Machines designed to weld turbine bucket wheels to 3¼-in. shafts for jet propulsion engines. Each is hydraulically operated and equipped to take shafts from 1 to 6 in. in diameter, 12 to 72 in. long, and bucket wheels from 5 to 40 in. in diameter. With slight changes in fixture design, machines can be used to join similar pieces for other purposes.

22-121. **Welding Electrical Equipment.** *Welding Engineer,* v. 31, Feb. '46, p. 56, 58, 60.

New techniques developed for vacuum-tight seams and joints.

22-122. **Progress in Staybolt Applications.** *Railway Mechanical Engineer,* v. 120, Feb. '46, p. 75-79.

Seal welding gives excellent results and setting staybolts by use of explosives is under test; influence of staybolt practices and leakage on life of firebox steels is reported.

22-123. **Illinois Central Overcomes Adverse Conditions on Cairo Bridge. Part II.** *Railway Engineering and Maintenance,* v. 42, Feb. '46, p. 156-159.

Problem of pounding of wheel loads at the rail ends overcome by replacing the old well-worn 90-lb., 39-ft. rails on the river spans with a series of continuous pressure butt-welded rails, up to 1058 ft. length, which are separated by switch-point-type expansion joints to take care of expansion and contraction.

22-124. **A Discussion of the Two E6013 Welding Electrode Types.** Orville T. Barnett. *Steel,* v. 118, March 4, '46, p. 122-123, 159, 162, 164, 170.

Discusses properties of both "A" and "U" types and their advantages; former seems best suited for sheet metal and the latter for heavier work.

22-125. **Resistance Welding for Sheet Metal Shops.** Harold S. Card. *Sheet Metal Worker,* v. 37, Feb. '46, p. 44-46, 52.

Wartime improvements in resistance welding machines and methods help speed and cut the costs of production.

22-126. **Uniwelding Aircraft Landing Gear.** E. R. Proctor. *Western Machinery and Steel World,* v. 37, Feb. '46, p. 62-65.

Description of process; advantages over conventional forms of welding.

22-127. **Stampings Plus Welding or Brazing Equal Profits.** *Western Machinery and Steel World,* v. 37, Feb. '46, p. 74-76.

Studies during the past two years by the Pressed Metal Institute reveal that: *(a)* It is often possible to break down complicated parts into a group of stampings to be assembled into the completed part by welding and brazing; *(b)* such redesigns save machining time; *(c)* increased output is obtained; *(d)* over-all production costs are cut.

22-128. **Processing and Fabrication of Stainless Steel Sheet and Plate Products. Part V.** H. S. Schaufus and W. H. Braun. *Steel Processing,* v. 32, Feb. '46, p. 106-109, 126-127.

Joining of chromium-nickel materials; oxy-acetylene gas welding.

22-129. **Controlling Distortion in the Gas Welding of Sheet Metals.** C. G. Bainbridge. *Sheet Metal Industries,* v. 23, Feb. '46, p. 356-362.

Control of distortion should be a matter of cooperation between designer and welder in selecting the type of joint and its location, bearing in mind the available means of preparing and jigging the welding edges. Also, jigs should

not be expected to correct or compensate for faults in joint preparation or welding procedure.

22-130. **The Welding of Non-Ferrous Metal. Part VII.** E. G. West. *Sheet Metal Industries,* v. 23, Feb. '46, p. 347-355.
Carbon arc and other welding processes for aluminum and its alloys. 7 ref.

22-131. **Multiple Resistance Welding.** W. A. Knipe. *Machinery (London),* v. 68, Feb. 7, '46, p. 169-174.
Short survey of the trend and progress of resistance welding machine design and technique.

22-132. **Report of Committee on Rails of the A.R.E.A.** W. H. Penfield, Chairman. *Bulletin of the American Railway Engineering Association,* v. 47, no. 458, Feb. '46, p. 365-480.
Reports of subcommittees on continuous welding of rail, service tests of various types of joint bars, joint bar failures, corrugated rails, rail designs.

22-133. **Uniwelding Produces High Joint Efficiency.** E. R. Proctor. *Iron Age,* v. 157, March 7, '46, p. 46-51.
Joints made by this method show no line at the weld, and the grain pattern is complete, and interlocks across the weld plane, resulting in 100% joint efficiency. Due to the absence of weld metal there is a substantial saving in weight, and joints so welded respond to heat treatment in the same manner as the parent metal.

22-134. **Flash-Butt Welder for Turbine Shafts.** *Iron Age,* v. 157, March 7, '46, p. 58-59.
Machine, hydraulically operated, is a vertical flash-butt welder designed to join solid steel shafts to the turbine bucket wheels of jet propulsion engines; it is equipped to take shafts up to 6 in. diameter, 72 in. in length and bucket wheel diameters of 5 to 40 in. Joining of similar pieces for other purposes can be effected on these machines by slight changes in fixture design.

22-135. **Proportioning of Weld Sizes.** Clyde M. Leavitt. *Welding Journal,* v. 25, Feb. '46, p. 121-129.
Describes a typical failure of an all-welded vessel.

22-136. **Efficient Arc Welding by Means of Proper Procedures.** W. J. Conley. *Welding Journal,* v. 25, Feb. '46, p. 131-141.
A weld can be made either by piling most of the metal on outside of the joint or by penetrating into root. Weld that is deeply penetrated will be much lower in cost. Amount of penetration and resultant economy are proportional to current used, combined with the effectiveness of use of arc force. Greater penetration results in substantial savings such as: fewer pounds of electrode necessary per foot; less power per foot; decreased need for gaps between plates, minimizing weld metal and saving labor and power; elimination of plate beveling in many cases and elimination of back-chipping.

22-137. **The Surface Preparation of Aluminum Alloy Sheet for Spot Welding.** R. A. Wyant, D. J. Ashcraft, T. B. Cameron, and K. H. Moore. *Welding Journal,* v. 25, Feb. '46, p. 65s-76s.

Effect of factors associated with precleaning, rinsing and heat treatment. Stability of surface films. Electron diffraction studies. 6 ref.

22-138. **Preliminary Study of the Notched-Bead Slow-Bend Test for Weldability of Steels.** C. B. Voldrich, R. W. Bennett and D. C. Martin. *Welding Journal,* v. 25, Feb. '46, p. 77s-90s.

Tests included studies of several notch shapes and depths, various aging treatments which have been found to alter the properties of the bend specimen, and the effect of plate thickness on the behavior of the specimen during bending. Findings summarized.

22-139. **A Study of Austenitic Welding for Control of Graphitization in Steel.** I. A. Rohrig. *Welding Journal,* v. 25, Feb. '46, p. 90s-101s.

Investigation covered: *(a)* examination of an 18-8 chromium-nickel weld between carbon-molybdenum and 18-8 nickel pipe, after 20,000 hr. of service at 925° F., which revealed carbon migration from the carbon-molybdenum pipe metal to the austenitic filler metal; *(b)* laboratory tests at 1000 to 1200° F., which showed carbide absorption by both 18-8 and 25-20 chromium-nickel austenitic filler metal from both high aluminum and low aluminum types of carbon-molybdenum pipe; *(c)* graphitization tests of welds made in samples of pipe from the Springdale plant of the West Penn Power Co. in which graphitization was first observed. Sample welded with carbon-molybdenum filler metal showed incipient "chain" type graphitization whereas sample welded with austenitic filler metal did not.

22-140. **Metal Flow and Fillet Formation in Brazing Aluminum.** Mike A. Miller. *Welding Journal,* v. 25, Feb. '46, p. 102s-114s.

Size and shape factors of fillets formed in various capillary environments; a number of relationships established by a trigonometric evaluation of the data. Aluminum brazing alloys are inherently fillet-formers. Technical surface tension of several filler materials was determined by measurements of the size and shape factors of two vertical, competing fillets. 14 ref.

22-141. **The Spot Welding of NE 8715, NE 8630 and SAE 4340 in the 0.062-In. Thickness.** W. F. Hess, W. D. Doty and W. J. Childs. *Welding Journal,* v. 25, Feb. '46, p. 123s-128s.

Optimum welding conditions for the spot welding and tempering of three different type steels in the 0.062-in. thickness. Results obtained show that the improvement in mechanical properties by tempering the weld increased with greater hardenability. 7 ref.

22-142. **Multiple Resistance Welding.** W. A. Knipe. *Machinery (London),* v. 68, Feb. 14, '46, p. 201-205.

Main benefits derived from multi-welding machines are: increased production due to increased speed of welding; a superior welded result obtained by accurate jigging and very little distortion; and a much improved power distribution over all phases of the supply, with less kva. per weld than on normal machines.

22-143. **Pressure Welding.** H. Herrmann. *Metal Industry,* v. 68, Feb. 22, '46, p. 143-147.

Manufacture of light alloy charge-cooler element; charge-cooler described was used with the Jumo 211F engine in Junkers 88 aircraft. (Article obtained in Germany by an investigating team.) 2 ref.

22-144. **Metallurgical Aspects of High Quality Pressure Welded Joints for Landing Gear. Part II. Tests, Set-Up and Inspection.** Leslie Fine, Charles H. Maak and Anthony R. Ozanich. *Metal Progress,* v. 49, March '46, p. 530-536.

Methods for physical testing of pressure butt-welds in aircraft tubing. Conclusion is that uniwelding gives the design engineer a weld which can, section for section, meet the requirements demanded of the base metal.

22-145. **Resistance Welding of Mild Steel.** Wilson Scott. *Tool Engineer,* v. 16, March '46, p. 58-60.

Electronic timing, switching and heat control permit exact control of quality and welding time.

22-146. **Ten Things to Watch in Making a Sound Arc Weld.** *American Machinist,* v. 90, March 14, '46, p. 102-103.

Points illustrated must not be considered separately but coordinated, one with the other, to produce the best weld deposit.

22-147. **Electricity Power Stations.** D. G. Sinfield. *Welding,* v. 14, Feb. '46, p. 54-61.

Developments of the welding department of C. A. Parsons & Co., Ltd., and the construction of electrical plant by that company; lay-out of shops and equipment installed.

22-148. **Bailey Bridge Production. Part 2.** C. A. Kershaw. *Welding,* v. 14, Feb. '46, p. 62-69.

Welding methods and control procedures.

22-149. **Welding of Nitralloy Steels.** D. Llewellyn. *Welding,* v. 14, Feb. '46, p. 70-73.

Report on recent progress.

22-150. **The Spot Welding of Magnesium.** R. F. Tylecote. *Welding,* v. 14, Feb. '46, p. 74-79.

Review of available literature in the United States.

22-151. **Welding Chromium-Nickel Steels. Part 2.** *Welding,* v. 14, Feb. '46, p. 80-89.

Metallurgical factors involved in the welding of chromium-nickel steels, with special reference to columbium and titanium-stabilized types. Suitable joint preparation and welding techniques.

22-152. **Brazing.** W. H. Hansen. *Metal Industry,* v. 68, March 1, '46, p. 163-165.

Use of protective atmospheres in electric resistance furnaces. (Translation from *Metallwirtschaft.*)

22-153. **Resistance Welding of Heat Resisting Materials: Application to Stainless Steel, Inconel and Nickel-Chromium Alloy.** H. E. Lardge. *Aircraft Production,* v. 8, March '46, p. 107-113.

Some of the results obtained in the application of resistance welding to such materials.

22-154. **Flash Welding Aluminum.** Gilbert C. Close. *Light Metal Age,* v. 4, Feb. '46, p. 12-14.

Advantages to the aluminum industry of wider application of the process of flash welding; fundamentals of this process. Considered are: "flashing" and upset cycles; weld characteristics; equipment; alignment and spacing of dies; and other factors. The profitable employment of flash welding machines for the production of small upset forgings is also described.

22-155. **Notes on Welding Stainless Steel.** H. A. Campbell. *Western Metals,* v. 4, Feb. '46, p. 17-19.

Discussion confined to thin sheets (less than 0.125 in.) of the 18-8 chromium-nickel alloys and their immediate relatives in the austenitic family. Gives major variables in welding of this kind.

22-156. **Soft Soldering, When Engineered, Can Do a Better Job.** *Electrical Manufacturing,* v. 37, March '46, p. 134-136, 138, 198, 200, 202, 204, 206, 208.

Considerations affecting soldering, importance of plastic range; theory of soldering; soldering devices; induction soldering iron.

22-157. **Silver Alloy Brazing of Copper Tubing.** J. S. Powers, Jr. and H. DeM. Lucas. *Steel,* v. 118, March 18, '46, p. 112-114, 116, 118.

Physical and flowing characteristics of the silver alloy make it possible to join ferrous and non-ferrous metals with the assurance of strong, ductile, leak-tight and corrosion resistant joints. Joint is penetrated completely. Low temperature at which the alloy melts (1270° F.) makes it ideal for use on copper and avoids the possibility of burning the copper through overheating; low melting point also materially reduces the time required.

22-158. **Pre-Welding Treatment for Aluminum.** B. B. Button. *Steel,* v. 118, March 18, '46, p. 132, 137-138.

Cuts contact resistance thereby greatly improving quality and quantity of spot welds; also prolongs life of electrode tips and eliminates need for tedious and expensive mechanical cleaning methods.

22-159. **R-F Soldering of Metal-to-Glass Seals.** R. A. Ammon. *Electronics,* v. 19, March '46, p. 120-121.

Design of r-f power supplies of about 30 mc. for the production of solder sealed meters capable of withstanding 25-in. vacuum.

22-160. **Soft Solders and Soldering Technique.** L. G. Earle. *Sheet Metal Industries,* v. 23, March '46, p. 515-521.

History and properties of soft solders; fundamentals of joint formation and solder penetration.

22-161. **Wartime German Ship Welding.** *Iron Age,* v. 157, March 21, '46, p. 54-58.

Information as to the composition of steels, as well as the composition of the electrodes and electrode coatings.

22-162. **Welding Turbo-Jet Engines.** W. J. Campbell. *Welding Engineer,* v. 31, March '46, p. 33-35.

Spot, seam, atomic-hydrogen and metal-arc welding.

22-163. **Nickel-Lined Pressure Vessel.** Donald E. Evans and Walter B. Meyer. *Welding Engineer,* v. 31, March '46, p. 38-40.

Either clad steel or separate linings may be used for corrosion resisting interiors of pressure vessels for production of 100-octane gasoline, where use of hydrofluoric acid brings new corrosion problems. Example given of conversion of existing pressure vessel by lining with ⅛-in. nickel sheet.

22-164. **Tool Tips Induction Brazed.** T. A. Vernor and E. F. Adams. *Welding Engineer,* v. 31, March '46, p. 53.

Silver brazing plus induction heating speeds up the job of replacing worn tungsten cutting tips on steel shanks. Tip 1½ x 1½ in. can be brazed in 30 sec.

22-165. **"Whale" Piers for Mulberry.** A Lamonde and R. G. Braithwaite. *Welding Engineer,* v. 31, March '46, p. 49-52.

Fabrication of the floating bridges for piers used in invasion of Europe; the work involved some 350 miles of structural welding.

22-166. **Three Coatings for Stainless Steel Welding Electrodes.** Orville T. Barnett. *Steel,* v. 118, March 25, '46, p. 98-100, 148-149.

Compares welding performance of three types of coatings on horizontal fillet weld. Possibility of the a.c-d.c. type displacing the titania type.

22-167. **Welding Boiler Tubing.** *Canadian Metals and Metallurgical Industries,* v. 9, March '46, p. 39-40.

Pressure welding used to join together standard lengths producing continuous tubing 95 ft. in length.

22-168. **Spraying Filler Metals on Brazed Joints.** *Iron Age,* v. 157, March 28, '46, p. 52-54.

Results of an investigation to determine possible advantages of applying filler material for brazing by spraying. Comparison of bond areas and shear strength of sprayed filler metal joints versus the usual wire filler joints. Study was made by the production development laboratory, North American Aviation, Inc.

22-169. **Welding Stainless Steel. Part I.** C. C. Hermann. *Materials and Methods,* v. 23, March '46, p. 713-716.

Difference in welding characteristics between stainless steel and mild steel. Common welding positions used; ways of reducing waste.

22-170. **Electric Furnace Copper Brazing of Steel Parts.** H. M. Webber. *Materials and Methods,* v. 23, March '46, p. 725-728.

Example of what can be done is afforded by the practice and experience of two companies who applied electric furnace copper brazing in the manufacture of the M-74 C.W.S. incendiary bomb. Methods described concerned chiefly with tail-cup and tail-plug assemblies.

22-171. **Processing and Fabrication of Stainless Steel Sheet and Plate Products. Part V—Joining of Chromium-Nickel Materials.** H. S. Schaufus and W. H. Braun. *Steel Processing,* v. 32, March '46, p. 164-167.

Metallic-arc welding and its advantages. Prevention of carbide formation; electrodes; preparation for welding; welding technique.

22-172. **Heliarc Welding of Magnesium.** *Modern Metals,* v. 2, March '46, p. 17-18.

Some of the development work which brought about a simple welding method for magnesium.

22-173. **Metallurgical Features in Welded Steels.** Hugh O'Neill. *Transactions of the Institute of Welding,* v. 9, Feb. '46, p. 3-9.

Conditions affecting the weldability of high-strength steels are reviewed. Progress report given on simple weld ductility test. From a study of the welding of steel as conducted both in the primitive smith's hearth and by modern nonfusion processes, a critical definition of the art is suggested. Fusion welding of ordinary steels is considered with reference to the curious local hardening produced in ferrite by "stray flashes". Wöhler fatigue tests on a low-alloy steel intentionally provided with these hard spots indicate the danger of such isolated arc craters in structures subjected to dynamic stresses.

22-174. **Operation Pluto: the Hamel Steel Pipe Lines.** J. S. Blair. *Transactions of the Institute of Welding,* v. 9, Feb. '46, p. 14-19.

An engineering achievement that was at one time regarded as a technical impossibility consisted in laying two types of pipe line under the English Channel—HAIS cable, which consisted of an electric submarine cable without cores and insulation through which petrol could be pumped, and the Hamel pipe line which consisted of 3-in. nominal-bore steel tubes electrically flash welded together into the full length required for laying.

22-175. **Versatile Welding Equipment.** *Machine Tool Blue Book,* v. 42, April '46, p. 237-238.

Use of single versatile, high-production portable installation for spot welding has enabled the Vering Mfg. Co., Los Angeles, to reduce production time 30% over former methods of assembly in fabricating large refrigeration units. Installation consists of only two welding guns operating from a single transformer and with a single timer and air-hydraulic booster. Both guns can be operated in either vertical or horizontal positions.

22-176. **Resistance Welding of Sheet Metal.** R. T. Gillette. *Heating and Ventilating,* v. 43, March '46, p. 76-79.

Tools and new techniques.

22-177. **Welding Magnesium.** M. M. Moyle. *Western Machinery and Steel World,* v. 37, March '46, p. 110-113, 136.

Cleaning surfaces to be welded; arc welding; spot welding; resistance flash welding.

22-178. **Causes and Prevention of Defects in Welding.** Frederick S. Dever. *Western Machinery and Steel World,* v. 37, March '46, p. 118-121, 138-139.

Gas welding defects; atomic hydrogen welding defects; spot welding defects.

22-179. **Electric Tube Borium Extends Life of Tool Joints in Ratio of Over 3 to 1.** *Fusion Facts,* v. 11, Feb. '46, p. 104-106.
Standard hard facing procedures using the electric arc.

22-180. **Application of High-Frequency Heating to Silver Brazing and Silver Soldering.** Herman A. Folgner. *Western Metals,* v. 4, March '46, p. 35-37.
Offers following advantages: simplicity of operation; low cost; high speed; control of heat.

22-181. **Shop Notes on Welding Stainless Steel.** *Journal of the American Society of Naval Engineers,* v. 58, Feb. '46, p. 90-96.
Practical discussion of the factors with which shop personnel who weld stainless steel should be familiar. (Reprinted from the Aug. 1945 issue of *Welding Journal.*)

22-182. **Production Methods by Silver Brazing.** R. A. R. *Machinery (London),* v. 68, March 7, '46, p. 297-303.
Induction heating, gas furnace, and hot dipping method.

22-183. **Measuring Eccentricity of Welding Electrode Coatings.** H. P. Zade. *Iron Age,* v. 157, April 11, '46, p. 46-49.
Several methods, both optical and electrical, by which accurate measurements may be made.

22-184. **Automatic Induction Brazing Speeds Tool Tipping.** *Iron Age,* v. 157, April 11, '46, p. 54-55.
Increases production with no increase in manpower. Rotary fixture enables one operator to do in 1 hr. what formerly was achieved in approximately 8 hr.

22-185. **Filler Metal Flow in Brazed Steel Joints.** *Iron Age,* v. 157, April 11, '46, p. 60-61.
Investigation to determine distance silver alloy filler metal will flow in steel brazing operations in relation to joint spacing, type of parent metal and direction of flow. Parent metals used in the tests were S.A.E. 1020, N.E. 8630 and stainless Type 302.

22-186. **Repair to Guillotine Shear Bed.** E. E. Wright. *Welder,* v. 14, Jan-Dec. '45, p. 2-3, 7.
Example of successful substitution of a fabricated mild steel bed for an existing cast iron bed.

22-187. **Underwater Arc Welding.** *Welder,* v. 14, Jan-Dec. '45, p. 4-7.
Electrodes; welding technique; vertical; overhead; welding accessories.

22-188. **Fabricated Cylinder Block in Mild Steel.** T. Tolworthy. *Welder,* v. 14, Jan-Dec. 45, p. 9.

22-189. **All-Welded Cantilever Pile-Driving Frame.** *Welder,* v. 14, Jan-Dec. '45, p. 10-14.
Fabrication of all-welded cantilever pile-driving frames. General view of frame is shown which also indicates procedure for driving piles.

22-190. **Typical Designs for Welded Steel Roof Trusses.** H. V. Hill. *Welder,* v. 14, Jan-Dec. '45, p. 16-19.
Typical details of the slated roof trusses. Similar details for roofs covered by means of asbestos cement sheeting and fiber boarding. Weights of steel given.

22-191. **Bottom Half of a 4-Ft. Hydraulic Riveting Machine Repaired by Welding.** W. Simpson. *Welder,* v. 14, Jan-Dec. '45, p. 20.

Illustrations show where break occurred and the way in which it was prepared for welding. When the metal (cast steel) in the vicinity of the break was examined, it was found to be very porous and full of dirt or sand. Porous metal was removed with the oxy-acetylene burner and all surfaces dressed and cleaned with a pneumatic chipping machine. All the surfaces were then ground smooth with a portable grinder.

22-192. **Spot Welding of Light Metals in Aircraft Manufacture.** W. Heiz. *Engineers' Digest (American Edition),* v. 3, March '46, p. 118-121.

Spot welding as a method of jointing can only be compared with riveting. Experience in practice may be needed before definite conclusions can be formed whether spot welding, in the manufacture of aircraft, should replace riveting to a larger extent than is usual at present. (Abstract from *Schweizer Archiv.,* v. 10, no. 8, p. 241-252.)

22-193. **U. S. Navy Developments in Underwater Cutting.** Bela Ronay and Cyril D. Jensen. *Welding Journal,* v. 25, March '46, p. 201-209.

Investigation to modernize arc-oxygen cutting. Resulted in: *(a)* new electrode design; *(b)* new torch design; *(c)* simplification of the technique for using the new materials; *(d)* standardization of the new procedure; *(e)* improved safety features in applying the procedure; *(f)* performance equal to that obtainable with oxy-acetylene in air. (Reprinted from Nov. 1945 issue of *Journal of the American Society of Naval Engineers.*)

22-194. **Underwater Cutting and Welding.** Chas. Kandel. *Welding Journal,* v. 25, March '46, p. 209-212.

Review of the latest methods for underwater cutting and welding. Performance and limitations of each method discussed. Safety precautions are emphasized.

22-195. **Special Oxy-Acetylene Machine Cutting Applications.** R. F. Helmkamp. *Welding Journal,* v. 25, March '46 p. 213-222.

Electronic tracer; stainless steel cutting; hot cutoff machines; special cutting adaptations; billet nicking; slab slitting and plate ripping; heavy scrap cutting; oxygen lance.

22-196. **Some Improvements Resulting From Studies of Welded Ship Failures.** David B. Bannerman, Jr., and Robert Tyrrell Young. *Welding Journal,* v. 25, March '46, p. 223-236.

History of failures in welded ships; causes of failures; measures taken to avoid structural failures; results of applying experience. (Paper presented before Society of Naval Architects and Marine Engineers, Dec. 6, 1945.)

22-197. **Welded Gas-Turbine Rotors.** John F. Cunningham, Jr. *Welding Journal,* v. 25, March '46, p. 237-241.

Gives results of program to test designs of joints and methods of fabrication which would give the least possi-

ble welding distortion and distortion only of a predictable nature.

22-198. **Conversion of a Portable Crane to Welded Design.** F. W. Kessler. *Welding Journal,* v. 25, March '46, p. 242-245.

By proper use of the simplicity, flexibility and rigidity of welded tubular construction, the engineers cut the weight of the model shown 1225 lb. Saving in weight makes it possible for girl to move crane, where formerly it required two or three men. For hoisting mechanism a self-locking worm and wheel was developed which worked much easier, enabling a 60-lb. force, applied to an 18-in. radius crank, to lift 6000 lb. on the hook.

22-199. **A Method for Welding Sheet Aluminum to S.A.E. 4140 Steel.** W. F. Hess and E. F. Nippes, Jr. *Welding Journal,* v. 25, March '46, p. 129s-148s.

Investigation involves a study of a large variety of different metals used as an intermediate metal between aluminum and steel for the purpose of securing a good bond both from the viewpoint of strength and thermal conductivity. A satisfactory bond was secured between aluminum and steel by electroplating the steel with a layer of silver of proper thickness. Welding equipment was then used to make a proper bond between the aluminum and the silver plating. Investigation includes the study of the best possible electroplating technique for securing bonds of maximum strength between the plated metal and the steel. Electroplating procedures were carefully studied and optimum conditions developed for the plating of bonds of maximum strength upon steel.

22-200. **An Investigation of Electrode Pressure-Cycles and Current Wave-Forms for Spot Welding Alclad 24S-T.** W. F. Hess, R. A. Wyant, B. L. Averbach and F. J. Winsor. *Welding Journal,* v. 25, March '46, p. 148s-162s.

Relative merits of the constant electrode-pressure cycle and the variable electrode-pressure cycle in which the weld is made at a low pressure and then subjected to a higher "forging" pressure; time interval between current peak and application of the forging pressure; ratio of the welding to the forging pressure; effects of varying the rate of current rise in condenser-discharge welding; effects of applying an a.c. preheat and an a.c. postheat in condenser-discharge welding. 10 ref.

22-201. **Supplementary Report of Model Tests of Weld Reinforcements for the Hatch Corners of Welded Ships.** G. L. Smith. *Welding Journal,* v. 25, March '46, p. 163s-170s.

Tests to determine *(a)* the strains set up during the test at various distances across the plate in line with the corners of the hatch or slot, and *(b)* the usefulness of weld reinforcements to resist fatigue and thus to prevent a crack from developing at a stress raiser such as a saw cut. To explore *(a),* five specimens were tested by taking strain-gage measurements at eight stations across the specimen for each 100,000 lb. increase in tensile load applied. To explore *(b),* 19 specimens were tested under cycles of completely reversed tensile and compressive

stress. All plates were provided with stress raisers in the nature of a transverse saw cut on each lateral edge and 11 of them were reinforced with longitudinal welds laid across the ends of the saw cuts. Results given.

22-202. **Impact Shear Strength of Silver-Alloy Brazed Joints.** H. A. Smith and P. A. Koerner. *Welding Journal,* v. 25, March '46, p. 188s-192s.

Investigation to determine strength of silver brazed lap joints when subjected to shear stresses caused by impact loadings and to compare such strengths with those developed in shear by static loadings.

22-203. **The Application of Electronic Control to Bench Welders.** L. J. G. *Machinery (London),* v. 68, March 14, '46, p. 335-338.

Strength and duration of current; use of thyratrons and ignitrons; advantage of half-cycle current.

22-204. **Tubular Members.** I. H. Hogg. *Welding,* v. 14, March '46, p. 104-108.

Methods of preparation for welding.

22-205. **Electricity Power Stations, Part II.** D. G. Sinfield. *Welding,* v. 14, March '46, p. 109-119.

Procedure for the fabrication of plant.

22-206. **Pressure Welding.** H. Herrmann. *Welding,* v. 14, March '46, p. 120-126.

Production of light alloy charge-cooler elements. Charge-cooler described was used with the Jumo 211F engine in Junkers 88 aircraft.

22-207. **Arc Welding Electrode Coatings.** H. P. Zade. *Welding,* v. 14, March '46, p. 127-131.

Various methods which can be used for the determination of eccentricity of electrode coatings.

22-208. **Friction Welding.** Kenneth Rose. *Welding,* v. 14, March '46, p. 132-133, 136.

Details of a method developed in the U. S. A. for bonding plastics, which can also be used for joining plastics with other materials. (From *Materials & Methods,* Dec. 1945.)

22-209. **Cast Iron Welding.** A. S. Prince. *Welding,* v. 14, March '46, p. 134-135.

Use of the oxy-acetylene flame.

22-210. **High-Strength Pressure Welded Joints.** C. B. Voldrich and J. L. Zambrow. *Steel,* v. 118, April 15, '46, p. 98-99, 136, 138, 140-142, 144.

Improvement in designs of machines may result from tests recently completed on new pressure welding processes for alloy steels. Various oxy-acetylene pressure welding tests on $3\frac{1}{16}$ and $3\frac{3}{16}$-in. o.d. by $\frac{13}{32}$-in. wall A-4135 seamless steel tubing. Objectives of the tests: *(a)* To determine structural properties of pressure welded joints; *(b)* to determine the most favorable welding technique for several sizes, shapes and steel compositions; *(c)* to determine the range of variation in welding technique that can be tolerated; *(d)* to investigate the effects of individual variables in the process (pressure, temperature,

duration of heating, sequence of operations) on the quality of the pressure welded joints.

22-211. **Adhesives and Theory of Adhesion.** *Steel,* v. 118, April 15, '46, p. 100-104, 106, 108, 110.

Survey of nature of adhesion is based on physical and chemical forces involved in applications of adhesives for bonding metal, wood, rubber and plastic parts. 18 ref.

22-212. **Hard Surfacing Light Metals.** W. C. Reid. *Modern Metals,* v. 2, April '46, p. 6-7.

Metalizing has possibilities where surface contact and wear are severe on reciprocating equipment parts; also for heavy or massive parts which require rugged wearing properties. Printing machine rolls are being made of aluminum and coated with stainless steel, monel, nickel or bronze.

22-213. **Induction Brazing of Carbide Tips to Tools.** *Machinery,* v. 52, April '46, p. 177-178.

Greatly increased output, with no increase in manpower, and reduced costs are claimed for this method. Two 15-kw. two-station, 9600-cycle, Tocco induction heating units with water-cooled, interchangeable coils to accommodate different tools are used.

22-214. **Electronics Actuates Tracer Control.** R. F. Helmkamp. *Machine Design,* v. 18, April '46, p. 137-142.

Known as "Electronic Bloodhound", method of control radically simplifies cutting operations, while at the same time assuring greater tracing accuracy, especially when complex cuts are required. Traces from easily prepared outline drawings or silhouettes with uniform accuracy whether the order calls for one piece or a thousand pieces.

22-215. **Arc Welding Equipment in Wartime Germany.** F. W. Myers. *Iron Age* v. 157, April 25, '46, p. 46-50.

Salient points and operating procedure of numerous types of automatic and semi-automatic welding equipment.

22-216. **Electronic Control in Resistance Welding.** B. G. Higgins. *Aircraft Production,* v. 8, April '46, p. 155-159.

Operation of electronic valve controllers to insure constant weld times and accurate repetition of short times.

22-217. **Pressure Welding.** R. F. Tylecote. *Aircraft Production,* v. 8, April '46, p. 160.

Results obtained from an investigation into the welding of light alloys by the application of pressure at temperatures below the melting point of the material to be joined. (From *Transactions of the Institute of Welding,* Nov. 1945.)

22-218. **Atomic-Hydrogen Welding.** *Aircraft Production,* v. 8, April '46, p. 170-171.

Its application in the manufacture and repair of tooling equipment.

22-219. **Soft Solders and Soldering Technique.** L. G. Earle. *Sheet Metal Industries,* v. 23, April '46, p. 719-724.

Preparation of the work for soldering; flux application;

preheating; prevention of chilling; dip soldering; controlling the copper content of the bath; machine soldering.

22-220. **The Welding of Nonferrous Metals. Part VII. Aluminum Alloy Spot Welds.** E. G. West. *Sheet Metal Industries,* v. 23, April '46, p. 755-761.

Control methods and properties. Standard control test; inspection of welds; properties of welds; weldability; welding dissimilar materials and thicknesses; mechanical strength; metallurgical properties.

22-221 **The Manufacture and Welding of Sheet Metal Work for Jet Propulsion Engines.** H. E. Lardge. *Sheet Metal Industries,* v. 23, April '46, p. 762-766.

Materials--high nickel-chromium heat resisting alloy, austenitic stainless steel sheet, and mild steel sprayed with aluminum; methods of fabrication and assembly; welding processes—resistance welding for seam and spot welding, carbon-arc process; brazing and clean annealing; assembly and inspection; laboratory control; combustion research.

22-222. **High-Speed Spot Welding.** Bernard Gross. *Sheet Metal Industries,* v. 23, April '46, p. 767-770.

Some of the factors which must receive careful attention to insure successful high-speed spot welding, including machine design, tooling, maintenance, and personnel training. (Reprinted from *Iron Age.*)

22-223. **Soft-Soldering Nonferrous Metals.** *Oxy-Acetylene Tips,* v. 25, April '46, p. 44-47.

Suggestions for using substitute solders successfully.

22-224. **Common Sense in Welding Fundamentals. No. 4.** W. J. Conley. *Industry and Welding,* v. 19, April '46, p. 42-43, 74-77.

Mechanical properties.

22-225. **Welding Stainless Steel. Part II.** C. C. Hermann. *Materials & Methods,* v. 23, April '46, p. 992-994.

Proper welding procedure is important in fabricating stainless steel parts because of possible economies in time and savings in expensive materials.

22-226. **Induction Brazing.** Rex Baubie. *Materials & Methods,* v. 23, April '46, p. 1007-1010.

Control of variables an advantage; wide range of products that can be made by induction brazing includes small crankshafts, attaching shanks to drills and reamers; fastening lugs to hose clamps, fastening carbide tips to cutting tools, and making hydraulic, pneumatic, and refrigerator fittings.

22-227. **Greater Economies Possible With Silver-Brazed Assemblies.** *Steel Processing,* v. 32, April '46, p. 225-228.

Examples illustrate the versatility and value of silver brazing.

22-228. **Automatic Welding of Products to Be Porcelain Enameled.** R. H. Davies. *Enamelist,* v. 23, April '46, p. 5-7.

Lincolnweld process has eliminated hydrogen difficulty and has made stress-relieving procedure unnecessary. Twelve-gage steel is arc welded by hand at the rate of

30 in. per min. In 1 min. Lincolnweld process will weld 100 to 120 in.

22-229. **Welding Thin-Gage Stainless Steel.** William P. Brotherton. *Welding Engineer,* v. 31, April '46, p. 47-49.

Special techniques developed in atomic-hydrogen welding to produce ductile, corrosion resistant welds in thin-gage stainless aircraft parts.

22-230. **Mechanical Blacksmith.** *Welding Engineer,* v. 31, April '46, p. 56-57.

Electronically controlled welding press used successfully to join toe calks to shoes in mass production of horseshoes.

22-231. **Drums for Flame Cutting.** Clyde B. Clason. *Welding Engineer.* v. 31, April '46, p. 58-62.

Story of an electronic flame cutting machine that is controlled by "playing" a phonograph record type of drum. Set of four drums causes the cutting torches to travel north, south, east or west.

22-232. **A Study of the Behavior of Rutheniopalladium in Torch Flames, With the Object of Improving Soldering Technique.** R. H. Atkinson and G. P. Gladis. *Metals Technology,* v. 13, April '46, T.P. 1982, 9 p.

Materials and equipment; test methods; effect of different torch flames on rutheniopalladium; effect of oxy-acetylene flame on solders.

22-233. **Fusion Welded Locomotive Boilers.** John M. Hall. *Railway Age,* v. 120, April 20, '46, p. 816-817.

Bureau of Locomotive Inspection, Interstate Commerce Commission, clarifies its position and sets forth procedure to be followed in applying for consent for the use of the fusion welding process.

22-234. **Application of High-Frequency Heating to Silver Brazing and Silver Soldering.** Herman A. Folgner. *Automotive and Aviation Industries,* v. 94, May 1, '46, p. 38-40, 78, 82.

Design of joint is largely governed by shape of the parts to be joined. Considerations governing selection of lap or butt joint. Design of heating coil.

22-235. **Design of Fixtures for Projection Welding.** Mario L. Ochieano. *Iron Age,* v. 157, May 2, '46, p. 55-56.

Illustration shows a projection weld die for welding a dowel pin assembly. All components of the die are insulated from the current-carrying copper alloy and no magnetic materials are used.

22-236. **Joining of Light-Gage Metals.** H. Thomasson. *Canadian Metals & Metallurgical Industries,* v. 9, April '46, p. 16-20.

Various welding methods, along with their economics and application.

22-237. **Processing and Fabrication of Stainless Steel Sheet and Plate Products. Part V. Joining of Chromium-Nickel Materials.** H. S. Schaufus and W. H. Braun. *Steel Processing,* v. 32, April '46, p. 234-238, 248.

Main features of atomic-hydrogen welding, argon and

helium shielded-arc welding, submerged-melt welding, also termed Unionmelt welding, and resistance welding.

22-238. **Locomotive Radiator Headers.** F. C. Archer. *Steel,* v. 118, May 6, '46, p. 139, 160.

Automatic arc welding setup for Racine plant which mass-produces part for cooling engine jacket and oil is model of efficiency.

22-239. **110-Volt Welder.** *Steel,* v. 118, May 6, '46, p. 150-152.

By using energy stored in interval between welds, small spot welder gives high voltage performance on metal of relatively high thermal conductivity.

22-240. **Production Line Welding.** *Western Metals,* v. 4, April '46, p. 32-33.

Turns out 20 fabricated steel tanks per shift.

22-241. **Coast's Largest Flash-Butt Welder.** *Western Machinery and Steel World,* v. 37, April '46, p. 178-180.

Machine will weld either solid bar stock or tubing, and can weld cross sections of plain carbon steel with an area of 24 in. An area as small as ¼ sq. in. may be handled on the machine, yet its maximum is tubing 12 in. in diameter and 45 ft. long.

22-242. **Principles of Heliarc at Northrop.** *Western Machinery and Steel World,* v. 37, April '46, p. 190-191.

By using heliarc welding, magnesium sheets, extrusions and tubing can be welded into simple, light and rigid structures. Research program yielded methods of treating magnesium to make it less flammable and more resistant to heat. Magnesium castings containing foundry defects have been repaired with this process and welds equal to or stronger than the surrounding metal have been obtained. Weld metal is much more dense than the surrounding cast metal and far less susceptible to corrosion. Almost any thickness of cast metal that can be poured may be readily welded with this process.

22-243. **Fall-Away Jig Cuts Welding Time.** H. B. Fairbanks and G. L. Revell. *American Machinist,* v. 90, May 9, '46, p. 112-113.

Unique "fall-away" jig reduced fabricating time by about 3 hr. per frame, with one instead of two welders now needed for the work. In addition, the jig provided a means for assuring accuracy of the assembly which must be held within a plus or minus tolerance of $\frac{1}{16}$ in. on all dimensions.

22-244. **Oil Refinery Pressure Vessels.** E. P. S. Gardner. *Welding,* v. 14, April '46, p. 150-155.

A critical survey of the American methods of arc welding the linings of oil refinery pressure vessels. Types of lining and the various means of assembly.

22-245. **Applications of Projection Welding.** R. Bushell. *Welding,* v. 14, April '46, p. 156-168.

Types of projection, specifications, design of component parts, suitable machines, and appropriate jigs and fixtures. Devoted mainly to the projection welding of mild steel assemblies.

22-246. **Soldering and Brazing.** T J. Stewart. *Welding,* v. 14, April '46, p. 169-177.

Advantages of the processes and suitable types of equipment. Preparation and cleaning of material and joint design. Methods of securing satisfactory control of the operations.

22-247. **Reclamation of Tank Sprockets.** A. S. Young. *Welding,* v. 14, April '46, p. 185-187.

An application of hard facing alloys.

22-248. **Hermetically Sealed Steatite.** Henry H. Hausner. *Journal of the American Ceramic Society,* v. 29, May 1, '46, p. 123-128.

Problems of sealing metals to steatite are similar to those encountered in glass-metal seals but it is more difficult because four different materials must be joined, namely, steatite, glaze, metal oxide, and metal. Thermal expansion coefficient of these materials must obtain in a certain relationship to guarantee a hermetic seal. Use of high-chromium steel for sealing purposes and the properties of this steel are described. Some design criteria for hermetically sealing steatite bushings are discussed and hints on manufacturing these bushings are given. 11 ref.

22-249. **Bonding Rubber to Metals.** John H. Gerstenmaier. *Modern Metals,* v. 2, May '46, p. 13.

A brief outline of applications developed during recent months for rubber-bonded aluminum and magnesium products. Outlook for new applications.

22-250. **Riveting, Countersinking and Dimpling Magnesium Alloys.** L. B. Harkins. *Modern Metals,* v. 2, May '46, p. 20-23.

Procedure for riveting, dimpling and countersinking varies widely among firms who are fabricating magnesium. Best methods described in a manner understandable to the layman.

22-251. **The "Shooting Star" Engine.** *Machine Tool Blue Book,* v. 42, May '46, p. 219-224.

Utilization of many specialized types of welding was one of the main factors in the successful development of the General Electric Type I-40 jet-propulsion gas turbine.

22-252. **Flame-Planer Speeds Plate-Edge Preparation.** Francis A. Westbrook. *Machine Tool Blue Book,* v. 42, May '46, p. 227-234.

Flame-planing for edge preparation of steel plate for shipbuilding and other heavy steel construction provides a speed consistent with the speed of welding seams.

22-253. **Localized Surfacing Combats Wear, Corrosion.** A. R. Lytle. *Machine Design,* v. 18, May '46, p. 131-136.

Some of most important technical characteristics of flame welding; advantages of mechanization. (From a paper for American Welding Society.)

22-254. **Rivets and Bolts in Structural Design.** F. H. Frankland. *Fasteners,* v. 3, May '46, p. 4-6, 18.

Important changes in the use of structural bolts and rivets will probably result from recent revisions of A.I.S.C. and A.S.T.M. specifications.

22-255. **Fasteners Assembly Speeded Through Electric Power Drivers.** W. G. Burggraf. *Fasteners,* v. 3, May '46, p. 7-10.

Power drivers show up in the manufacturing operations in faster assembly, with consequent lowered costs, and uniform results. Gives examples of improvements in speed and time.

22-256. **13 Years on the Delaware & Hudson.** P. O. Ferris. *Railway Engineering and Maintenance,* v. 42, May '46, p. 528-532.

Detailed analysis of the experience of the Delaware & Hudson with both welded and angle-barred track construction, citing the opinions of both track supervisors and division engineers Eleven separate installations of welded track were under observation involving a total of 10,984 welds, some of which were made as early as 1933.

22-257. **Fabrication by Electric-Furnace Brazing.** H. M. Webber. *General Electric Review,* v. 49, May '46, p. 22-29.

Brazing fabrication work on incendiary bombs as done by the International Silver Co. plants.

22-258. **Flame Cutting, Flame Hardening and Welding on Railroads.** J. W. Kenefic. *Welding Journal,* v. 25, April '46, p. 299-307.

Description of a number of applications for the reclamation of obsolete equipment and the restoration of worn equipment.

22-259. **Atomic-Hydrogen Welding in Aviation.** Frederick S. Dever. *Welding Journal,* v. 25, April '46, p. 309-312.

Because of the cleanliness of the welds which are obtained by the use of this process and because of the narrow beads and greater speed obtained, it is felt by many that the atomic-hydrogen welding method will in the future replace, to a large extent, many of the existing welding processes.

22-260. **Flash Welding Alloy Steel Rings.** P. B. Scharf. *Welding Journal,* v. 25, April '46, p. 313-317.

Flash welding of alloy steels is not only practical but advantageous. Results are uniformly more accurate than those of previous methods, the amount of necessary subsequent machining being greatly reduced and even eliminated in many instances.

22-261. **N.E.M.A. Electric Arc Welding Machine and Electrode Standards.** *Welding Journal,* v. 25, April '46, p. 317-318.

Incorporates the desirable changes resulting from wartime experience and covers a most important postwar requirement, namely, welders for the farm and small community repair shops.

22-262. **Rebuilding Locomotive Wheels by Automatic Shielded-Arc Methods.** L. K. Stringham. *Welding Journal,* v. 25, April '46, p. 336-339.

Rebuilding of wheels for mine locomotives by submerged automatic metallic shielded-arc process resulted in much faster welding, denser weld deposits for increased resistance to wear and breakage and a cost reduction over the former welding procedure.

22-263. **Inspection of Welded Construction.** A. E. Poole. *Welding Journal,* v. 25, April '46, p. 341-342.

Three factors are essential if the work is to be accomplished expeditiously and economically with a minimum of trouble, namely, *(a)* a thorough and adequate design, *(b)* good construction methods and *(c)* thorough inspection. Good inspection in the fabricating shop as well as in the field decreases the cost of the work, accelerates completion and results in a superior product.

22-264. **Electric Resistance Brazing of Structural Aluminum Alloys.** W. F. Hess and E. F. Nippes. *Welding Journal,* v. 25, April '46, p. 193s-200s.

Electric resistance bonding of low-melting alloys electroplated and sprayed on aluminum alloy surfaces.

22-265. **Some Observations of Spot Weld Consistency in Aluminum Alloys.** W. F. Hess, R. A. Wyant, B. L. Averbach and F. J. Winsor. *Welding Journal,* v. 25, April '46, p. 201s-222s.

Some observations which have been made in the course of the aircraft spot welding research program. Weld consistency may be affected by following factors: performance of welding equipment; maintenance and method of operation of welding machine; surface condition; shape and condition of electrode tips; precision of testing methods.

22-266. **The Use of Direct Transformation Data in Determining Preheat and Postheat Requirements for Arc Welding Deep Hardening Steels and Weld Deposits.** L. F. Bowne, Jr. *Welding Journal,* v. 25, April '46, p. 234s-241s.

Preheating to prevent cracking and postheating for ductility. Treatments determined from TTT-curves. Examples of welding treatments which have produced satisfactory results on maintenance and production welding of tools and production welding of deep hardening weld deposits.

22-267. **The Mechanical Properties and Some Metallurgical Features of Copper-Brazed Joints.** R. F. Tylecote. *Welding Journal,* v. 25, April '46, p. 242s-248s.

Summary of previous work; fatigue strength; effect of time; effect of fit or shear strength; effect of brazing time; effect of heat treatment on shear stress; influence of cooling rate; tests on carburized specimens.

22-268. **Electric-Furnace Brazing.** H. D. Hendrick. *Machinery (London),* v. 68, May 9, '46, p. 585-591.

Continuous furnaces; semi-continuous furnaces; burnt town gas; hydrogen; cracked ammonia; burnt ammonia; brazing alloys and fluxes; design of components for brazing.

22-269. **Evaluation of the Quality of Pressure Welded Joints in Alloy Steels.** C. B. Voldrich and J. L. Zambrow. *Automotive and Aviation Industries,* v. 94, May 15, '46, p. 34-36, 64, 66.

The closed-joint pressure welding method was used, in which the faces to be joined are butted firmly together, heated from the outside and upset when the weld zone has become plastic Most of the tests were made on A 4135 chromium-molybdenum seamless steel tubing of $3\frac{1}{16}$ in. o.d. by $\frac{13}{32}$ in. wall thickness. (Extracts from research

report No. W-215 from the Office of Production Research and Development.)

22-270. **Induction Heating Brazes Tool Tips.** T. A. Vernor and E. F. Adams. *Industrial Heating,* v. 13, May '46, p. 807, 822.

Tool tips can be brazed on a 1½-in. tool in about 30 sec. using induction heating. Brazing job is speeded up and life of the tool is improved since the tungsten tip and the soft steel shank are heated at different rates and the tip does not reach the same temperature as the shank.

22-271. **Soft Solders and Soldering Technique.** L. G. Earle. *Sheet Metal Industries,* v. 23, May '46, p. 945-948, 954.

Hand soldering methods; electrical heating devices; fluxes; solder testing.

22-272. **The Welding of Nonferrous Metals. Part VII.** E. G. West. *Sheet Metal Industries,* v. 23, May '46, p. 961-970.

Concludes remarks on spot welding, and deals with other resistance welding processes, and with pressure welding. Fundamentals and technique of aluminum brazing are described.

22-273. **Some Notes on the Electricity Supply for Resistance Welders.** C. H. Pike. *Sheet Metal Industries,* v. 23, May '46, p. 971-974, 980.

Voltage regulation; effect of voltage drop; automatic voltage regulators; transformer rating; an example of transformer design; conductors; power factor.

22-274. **Electric Resistance Brazing of Structural Aluminum Alloys.** W. F. Hess and E. F. Nippes. *Welding Journal,* v. 25, April '46, p. 193s-200s.

Material used for study; equipment; procedure for applying bonding materials; procedure for electric resistance brazing; results on electrobrazed spot welded and seam welded specimens.

22-275. **Pressure Welding of Light Alloys Without Fusion.** *Aluminium and the Non-Ferrous Review,* v. 2, Jan-March '46, p. 6-12.

Materials used; apparatus used and method of working; surface preparation.

22-276. **Welded Pedestal Bearings.** E. W. Sjoquist. *Steel,* v. 118, June 3, '46, p. 112-114.

Changing from previously used types to welded type pedestal bearings for large electric motors permits lighter weight with no sacrifice in strength, performance, or appearance. Also, fabricated steel construction is faster, and better control of the material source is achieved. Through the use of special welding equipment, cost of welded fabrication is said to be comparable with former methods of construction.

22-277. **German Practice in Pressure Welding.** *Aircraft Production,* v. 8, May '46, p. 207-210.

Production of aftercooler for Junkers Jumo 211 J engine. Two thin aluminum sheets are laid cold, one on the other, between two hot welding "teeth" on dies. They are heated by the die and then pressed together.

22-278. **All-Welded Truck Trailers.** Fred M. Burt. *Welding Engineer,* v. 31, May '46, p. 35-38.

One production operation—arc welding—stands out above all others in the manufacture of truck trailers in the plant of the Fruehauf Trailer Co., Los Angeles.

22-279. **Welding Sequence at Swan Island. Part I.** Frank Robert Baysinger. *Welding Engineer,* v. 31, May '46, p. 40-43.

Most important of the procedures that made possible the assembly-line manufacture of tankers at Henry J. Kaiser's Swan Island yard was the end-to-middle sequence. Why and how it was developed.

22-280. **Welded Cranes and Heavy Machinery.** Clyde B. Clason. *Welding Engineer,* v. 31, May '46, p. 49-53.

Girders for overhead cranes; automatic welding gantry; disassembled for shipment; tramrail construction; making arch beams; all-welded presses; built-up end housing; deflection at a minimum; no slippage of parts; gears and bulldozers; rim welding procedure.

22-281. **Procedures for Welding Gray Cast Iron.** *Welding Engineer,* v. 31, May '46, p. 54-55.

Procedure details given are based upon the known effects of heat on gray-iron castings and upon the necessity for keeping the work clean.

22-282. **Butt Welder for Joining Strip Steel.** *Welding Engineer,* v. 31, May '46, p. 60.

Installation of a strip steel butt welder in the pickling line of a cold rolling mill makes the continuous production of strip steel virtually an accomplished fact.

22-283. **German Welding Rod Manufacture.** Clarence G. Merritt. *Iron Age,* v. 157, June 6, '46, p. 66-70.

Information on the development and manufacture of welding rods in wartime Germany obtained during the summer of 1945 at the Deutsche Edelstahlwerke, Bochum, and the Edelstahlwerke of Gebruder Bohler, near Dusseldorf. Rod and coating composition for a wide variety of German rods given.

22-284. **Processing and Fabrication of Stainless Steel Sheet and Plate Products.** H. S. Schaufus and W. H. Braun. *Steel Processing,* v. 8, May '46, p. 301-305.

Soldering and brazing of chromium-nickel materials.

22-285. **Bonding Aluminum to Steel or Cast Iron.** M. G. Whitefield and V. Sheshunoff. *Metal Treatment,* v. 8, Spring, '46, p. 70-76.

Shape factors, properties of the bond; effect on steels; general physical properties; fatigue strength; engine cylinder barrel comparison; three joining methods; performance of Al-Fin barrels; processing for barrel application; steel-backed aluminum bearings; special assemblies and applications. (From *Metals & Alloys,* Oct. 1945.)

22-286. **Important Elements of Sheet Metal Welding.** Orville T. Barnett. *Steel,* v. 118, June 10, '46, p. 86-87, 114.

Cost reductions may be gained by stressing welding fundamentals—fitup and joint design, position, electrodes, jigs and fixtures—because of their greater influence in joining light-gage metals.

22-287. **Silver Alloy Brazing.** Adolph Bregman. *Steel,* v. 118, June 10, '46, p. 94-95, 143.

Special silver brazing alloys which melt at temperatures from 1175 to 1300° F. are eminently satisfactory for making joints between many metals and alloys. Silver brazing alloys used in ordnance equipment listed are covered by Federal Specification QQS-561 d (U. S. Ordnance Department), U. S. Navy Specification 47S-13 (INT); and U. S. Army Chemical Warfare Service Specification 196-131-80. Flux used in conjunction with the silver brazing alloys is covered by Ordnance Department Tentative Specification AXS-500; U. S. Navy Specification 51F4a.

22-288. **Steel Erection Method.** *Steel,* v. 118, June 10, '46, p. 107, 144.

Simplifies and lowers cost of fabrication. Method, known as Saxe welded erection system, consists of using two simple drop forged steel parts—an erection seat which is shop welded to the steel column and an erection clip, also shop welded to the under side of the beam.

22-289. **Flame Brazing of Aluminum.** F. Clark. *Welding,* v. 14, May '46, p. 202-214.

Use of manual oxy-acetylene flame brazing on commercial aluminum and some types of alloy. Filler materials; fluxes; properties of the joints; equipment necessary; preparation and suitable technique; applications and suggestions as to future developments.

22-290. **Shipyard Layout and Technique for Welded Construction.** H. H. Hagan. *Welding,* v. 14, May '46, p. 215-222, 247.

The change-over from riveted to welded construction and the organizational problems involved. Data from experience gained in welded ship production are given in a practical form.

22-291. **Jigs for a Better Resistance Welded Job.** *Industry and Welding,* v. 19, May '46, p. 35-38, 52.

Development of proper jigs and fixtures makes lower cost fabrication possible.

22-292. **Cutting Heavy Locomotive Sections With the Oxy-Acetylene Flame.** *Industry and Welding,* v. 19, May '46, p. 40-41, 70.

Original frames, cut from rolled steel, were 29 ft. long. Those on order were 36 ft. in length, and required 230 ft. of cutting per frame, including its set of four stringer caps. Plan drafted for a setup to make longer frames in pairs instead of singly. Modifications made to cutting machine so that a second torch could be used far enough out to cover the width of the second steel slab, by adding a 24x3x3-in. tube bar to the existing 11-ft. 6-in. tube attached to the pantograph arms of the machine. Possible to cut two frames simultaneously; production time reduced to half.

22-293. **Oxy-Acetylene Safety Regulations at the Ford Motor Co.** *Industry and Welding,* v. 19, May '46, p. 42-43.

Rules that are applicable to the smallest shop.

22-294. **Bronze Welding Restores 35-Ton Locomotive Crane.** *Industry and Welding,* v. 19, May '46, p. 44-45, 76.
Repairs to center pin bushing.

22-295. **The Control of Distortion. I. Practical Consideration of Welding Stresses.** Orville T. Barnett. *Industry and Welding,* v. 19, May '46, p. 48-49, 74-76.
Problems of heat and stress in welding.

22-296. **The Practical Significance of Recent Work on the Pressure Welding of Light Alloys.** R. F. Tylecote. *Sheet Metal Industries,* v. 23, June '46, p. 1165-1167, 1178.
History, principles, and possible applications of the process to light alloys.

22-297. **The Welding of Nonferrous Metals.** E. G. West. *Sheet Metal Industries,* v. 23, June '46, p. 1168-1177.
Aluminum brazing—flux removal; jigging; oxy-gas, flame or torch brazing; furnace brazing; dip brazing; electric brazing; properties and applications; design considerations. Welding of magnesium—oxy-gas process. 10 ref.

22-298. **Resistance Welding—a Tool for High Production.** K. R. Van Tassel. *Tool & Die Journal,* v. 12, June '46, p. 105-106.
Resistance welding has the advantage of low cost, high employee productivity, better appearance, minimum distortion, and requires neither added material nor, in the case of automatic machines, special skill on the part of the operator.

22-299. **How to Weld Aluminum.** *Iron Age,* v. 157, June 20, '46, p. 50-55.
A review of modern techniques employed in welding aluminum, including gas, carbon-arc, metallic-arc, atomic-hydrogen and resistance welding, as well as brazing and soldering. Weldability of various aluminum alloys and the technique of gas welding.

22-300. **Multiple Tip Torches Speed Stainless Steel Welding.** William P. Brotherton. *Iron Age,* v. 157, June 20, '46, p. 70-73.
Among the many wartime developments at Ryan Aeronautical Co. are multiple tip gas welding torches that perform welding and cutting operations simultaneously, and improve weld quality on stainless steel.

22-301. **Production Processes—Their Influence on Design. Part XII—Flame Cutting.** Roger W. Bolz. *Machine Design,* v. 18, June '46, p. 115-121.
Advantages; applications; design of parts; materials; tolerances; equipment.

22-302. **40 Welds in 6 Seconds.** *Industry and Welding,* v. 19, June '46, p 38-39, 59.
Spot welding of movable steel partitions. No polishing or smoothing is required on the "finish" side. Knockout operation is eliminated, disking is cut down, and no glazing is required. Net result is a saving of time and money —and welding quality not possible with any other method.

22-303. **How to Weld Aluminum. Part 2.** *Iron Age,* v. 157, June 27, '46, p. 60-64.

Metal-arc, manual and automatic carbon-arc, atomic-hydrogen, and inert gas shielded-arc welding methods. Recommendations as to electrode size and type, joint edge preparation, and general operating technique.

22-304. **Simplifying Construction by Automatic Stud Welding.** *Iron Age,* v. 157, June 27, '46, p. 65-67.

Origin of the process and its development to its present highly efficient state; operation of the welding gun; its use as a production tool in various manufacturing operations.

22-305. **Joining Magnesium Alloys.** *Light Metals,* v. 9, June '46, p. 291-292.

British patent describes methods of joining or cladding metals, with particular reference to magnesium alloys, by use of metallic joining medium, not in the liquid state.

22-306. **Arc Welding Gray Iron Castings.** C. E. Phillips. *Western Machinery and Steel World,* v. 37, June '46, p. 118-120.

General description of welding procedure in building up castings.

22-307. **How to Weld Aluminum. Part 3.** *Iron Age,* v. 158, July 4, '46. p. 67-71.

Spot welding of aluminum and types of machines used. Preweld cleaning; advantages and disadvantages of various settings; electrode maintenance; trouble shooting.

22-308. **A Study of Electric-Arc Welding of Cavities in A.S.T.M. No. 4 Castings.** George W. Kurachek. *Light Metal Age,* v. 5, June '46, p. 8-12, 29.

Discusses maximum working limits on the depth of welding on castings of A.S.T.M. No. 4 alloy (6% Al, 3% Zn).

22-309. **Gas Turbines.** D. A. Oliver and G. T. Harris. *Iron and Steel,* v. 19, June '46, p. 379-381, 400.

Discusses work on flash butt welded disks and shafts. Advantages and disadvantages of the welded construction.

22-310. **Ryan Welding Innovations.** William P. Brotherton. *Welding Engineer,* v. 31, June '46, p. 37-39.

Ingenious gas, arc, and resistance welding techniques to join intricately formed stainless steel parts of exhaust manifolds.

22-311. **Power Shovel Redesigned for Welding.** R. D. Layman. *Welding Engineer,* v. 31, June '46, p. 42-43.

Welded fabrication of tubular assemblies saves 40% in the manufacturing cost of a portable power shovel.

22-312. **Welded Studs Step up Production.** E. A. Bonfield. *Welding Engineer,* v. 31, June '46, p. 44-45.

Welded studs can be used to secure bearings on machinery or bent to make such things as handles and hooks. Save production time.

22-313. **A. C. Welding Status in 1946, Part I.** Orville T. Barnett. *Welding Engineer,* v. 31, June '46, p. 52-54.

Development of superior equipment and electrodes.

22-314. **Steel for Petroleum Piping.** R. J. Pass. *Welding Engineer,* v. 23, June '46, p. 55-57.

Gives compositions and properties of steels in the different groups and tells how they may best be welded.

22-315. **Welding Sequence at Swan Island. Part 2.** Frank Robert Baysinger. *Welding Engineer,* v. 31, June '46, p. 62-66.

Tells why and how the end-to-middle sequence was developed to build T2-SE-Al turbo-electric tankers.

22-316. **New Cored Wire Solder.** R. G. Kocsis. *Steel,* v. 119, July 8, '46, p. 112.

Flux in four channels on outside of wire melts at temperature 250° lower than solder to eliminate prefluxing. Mild composition prevents discoloration of metal and resultant cleaning.

22-317. **Spot Welding Aluminum to 4140 Steel.** *Industry and Welding,* v. 19, June '46, p. 58-59.

Account of experiments conducted at Rensselaer Polytechnic Institute on how to bond aluminum to steel through use of an intermediate electrodeposited metal. Possibility of making the bond at a temperature below the critical temperature of the cylinder barrel steel (S.A.E. 4140).

22-318. **Oxy-Acetylene Cutting of Heavy Machinery Parts.** *Industry and Welding,* v. 19, June '46, p. 44-45, 57.

Oxygen-cut plate for welded crankcase cuts production time 75%.

22-319. **Metallic-Arc Welding Chromium-Nickel Steels.** *Industry and Welding,* v. 19, June '46, p. 50-51, 72-73.

Study of the factors to be considered when selecting an alloy and determining the correct welding procedure.

22-320. **The Control of Distortion, Part II.** Orville T. Barnett. *Industry and Welding,* v. 19, June '46, p. 40-41, 56.

Practical consideration of expansion and contraction.

22-321. **Phos-Copper Brazing of Armature Coils.** C. Lynn. *Modern Machine Shop,* v. 19, July '46, p. 136-138, 140, 142, 144, 146, 148, 151, 152.

Thin strips of phos-copper approximately 0.015 in. thick, with a width equal to approximately half the width of the neck in a direction parallel to the shaft, are inserted between each side of the armature coil ends and the neck. Heat from a brazing transformer is then applied with pressure to the joint by means of carbon-tipped brazing tongs. After the phos-copper has melted (815° C.) and has flowed over the surface to be brazed, the current is stopped but the pressure is maintained till the joint cools.

22-322. **Flame Cutting Stainless Steel.** George E. Bellew. *Iron Age,* v. 158, July 11, '46, p. 42-45.

New process for flame cutting stainless steels by the flux-injection method. Flux, in powdered form, is fed into the cut through the oxygen stream permitting cutting speeds comparable with those obtained on mild steel. Flux injection is provided by addition of a simple flux feeder to standard oxy-acetylene cutting equipment.

22-323. **How to Weld Aluminum. Part 4.** *Iron Age,* v. 158, July 11, '46, p. 53-57.

Modern seam and flash welding methods, soldering and brazing by the furnace, dip and torch methods. Cleaning before and after brazing and final inspection of joints.

22-324. **Contact Arc Welding.** P. C. van der Willigen. *Welding Journal,* v. 25, May '46, p. 313s-320s.

A new type of welding electrode (developed at the Philips' Glow-lamp Works, Eindhoven, Holland) combines the properties of touch welding, self starting and reignition. The technique of welding with this electrode has been termed "contact arc welding." The very heavy conductive coating of these welding electrodes was obtainable by transferring a great part of the iron from the core wire to the coating, this iron being deposited in the weld.

22-325. **An Investigation of the Effect of Spot Welding on the Sheet Efficiency of Aluminum Alloy 24S-T.** W. F. Hess, R. A. Wyant, and F. J. Winsor. *Welding Journal,* v. 25, May '46, p. 288s-305s.

A preliminary study. Most of the investigation was confined to two types of specimen containing single-spot welds in 0.040-in. material. All specimens were tested under statically applied loads.

22-326. **Electrodes for Welding Chromium-Molybdenum Steel.** D. L. Mathias and G. M. Leigh. *Welding Journal,* v. 25, May '46, p. 399-405.

Two lines of electrodes for the welding of chromium-molybdenum steels are presented with all-position welding characteristics depositing metal of X-ray quality with ultimate strengths from 65,000 to 100,000 psi. and elongations from 17 to 25% when stress relieved at 1300° F. for 2 hr. Variations in the heat treating cycle expand the range of physical properties still further. The weld metal has a controllable composition which can be conveniently varied in 0.5% increments of both chromium and molybdenum.

22-327. **Boiler Patches: Bolted, Riveted or Welded?** Harry M. Spring. *Power,* v. 90, July '46, p. 103-105, 148.

Relative merits, fields of use and physical tests of the three major classes of boiler patches for maintenance.

22-328. **Fusion Welded Boiler on D. & H. Locomotive.** G. S. Edmonds. *Mechanical Engineering,* v. 68, July '46, p. 619-621.

Welded boiler is of wide-firebox radial-stayed type, with a sloping backhead, having a working pressure of 225 psi. It was applied to a consolidation-type locomotive No. 1219 which was placed in service in 1937. Principal characteristics of this locomotive are given.

22-329. **Locomotive Boilers—Welded Construction.** James Partington. *Mechanical Engineering,* v. 68, July '46, p. 622-624.

Formulating a code of safe welding practices; all-welded locomotive boiler of the D. & H. Railroad; boiler as stiffening member in locomotive structure; boiler code welding requirements; welded boilers built for war department.

22-330. **Prospective Use of Fusion Welded Locomotive Boilers.** John M. Hall. *Mechanical Engineering,* v. 68, July '46, p. 624, 629.

It is necessary under the terms of the Locomotive Inspection Act that adequate safety be built into all boilers used on locomotives and, through the filing of applications accompanied by drawings and specifications for consent for use by any railroad or railroads desiring to use welded boilers, that the required degree of safety will be provided.

22-331. **Resistance Seam Welded Sacks Used as Hydraulic Presses.** R. T. Gillette. *General Electric Review,* v. 49, July '46, p. 7-10.

For exerting extreme forces in confined spaces of various basic configurations. Initially devised for testing welds of dissimilar metals.

22-332. **Press Welding Aluminum Fins.** *Tool & Die Journal,* v. 12, July '46, p. 84-85.

Sheets of aluminum were virtually melted together between gas-heated dies closed under pressure. As the dies closed, compressed air was injected between the sheets to blow open areas between the welds. These areas created passageways conforming to the impressions in the die surface and the resultant sheets were then paired up and welded to produce aircraft radiators.

22-333. **Welding of Magnesium.** LeRoy F. Pearsall. *Welding Journal,* v. 25, June '46, p. 549.

Describes a 40-amp. magnetic switch designed by White Aircraft Corp. to start the high frequency current and welding current simultaneously to prevent burned spots caused by high-frequency arcs.

22-334. **Procedures for Arc Welding Gray Iron Castings.** C. E. Phillips. *Welding Journal,* v. 25, June '46, p. 547-548.

General classification includes castings which require building up with additional metal in certain areas. These jobs can be subdivided into typical groups which, in turn, require (1) a restoration of lost metal as in a broken gear tooth, (2) the filling of a cavity as in a porous or defective casting, (3) building up a surface which has been worn away or incorrectly machined, or (4) putting on metal to accommodate a change in design.

22-335. **Improvement of the Notch Impact Resistance of Gas-Welded Joints.** A. Matting and H. Koch. *Welding Journal,* v 25, June '46, p. 359s-360s.

The fact that even highly skilled workers with many years of experience in gas welding are unable to obtain consistent results in notch impact is a proof that the problem of gas welding of joints 9/16 in. thick and more is is far from being solved. There seems to be no point in trying to improve further the technique of welding. The solution seems to lie in the selection of a proper type of welding rod. (Abridged translation from *Autogene Metallbearbeitung,* v. 35, April '42, by D. Rosenthal.)

22-336. **Manual Oxy-Acetylene Flame Brazing of Aluminum, Aluminum Alloy Sheet and Subassemblies.** F. Clark. *Welding Journal,* v. 25, June '46, p. 505-513.

Parent material; filler material or brazing rod; flux; strength of filler metal and joint; fuel gas employed; equipment; flame adjustment; preparation; flame and rod manipulation; flux removal; some applications and procedure; future developments.

22-337. **Soft Soldering Nonferrous Metals.** G. H. Bohn. *Welding Journal,* v. 25, June '46, p. 513-516.

Blowpipes for soldering; melting and flowing temperatures of solders; fluxes for soft soldering; principles of successful soldering; types of flames; design of soft soldered joints; testing joints.

22-338. **Fundamentals Affecting the Bond in Pressure Welds.** Leslie Fine, Charles H. Maak and Anthony R. Ozanich. *Welding Journal,* v. 25, June '46, p. 517-529.

Voids present at the weld plane; theoretical aspects of bonding; plastic deformation due to up setting; plastic deformation due to surface energy; weld contaminants; physical testing. 11 ref.

22-339. **"Shooting Star" Engine Is Triumph for Modern Welding.** J G. Shaw. *Welding Journal,* v. 25, June '46, p. 529-530.

Utilization of many specialized types of welding to produce joints of great strength in lightweight metal was one of the main factors in the successful development of the General Electric Type I-40 jet propulsion gas turbine.

22-340. **Induction Brazing of Carbide Tools.** *Western Metals,* v. 4, July '46, p. 25-27.

Cost-cutting advantages: Eliminates removal of excess metal from the shank of the tool; does away with wiring tip to shank: reduces wear on the finish grinding wheels by elimination of the wiring on tip; is cooler and cleaner; is a more positive, uniform type of braze; holds rejects to a fraction of a per cent.

22-341. **Precision Flame Cutting in Quantity Production.** Fred M. Burt. *Western Metals,* v. 4, July '46, p. 32-34.

Typical examples illustrate what produces or parts can be formed more efficiently and economically by flame cutting.

22-342. **Metal Electric Processing Co. Equipped for Controlled-Atmosphere Brazing and Bright Annealing.** *Industrial Heating,* v. 8, July '46, p. 1206-1214.

Equipped with two continuous electrically heated brazing furnaces and a gas-fired silver-soldering continuous furnace for permanently joining metal parts into complete subassemblies and assemblies.

22-343 **Electric Furnace Copper Brazing.** Gordon B. Ashmead. *Western Machinery and Steel World,* v. 37, July '46, p. 88-90, 129.

Description of G.E. 320-kw. roller hearth with automatic charging and ejection; designing for copper brazing.

22-344. **Cast Iron Cutting.** *Western Machinery and Steel World,* v. 37, July '46, p. 91-94, 129.

Cutting cast iron 2 in. thick or over; cutting cast iron less than 2 in. thick; problems requiring special handling;

cutting hollow shafts; cutting cast iron pipe; "veeing" castings for welding; cutting holes, slots, etc.; removal of locomotive valve and cylinder bushings.

22-345. **High-Frequency Induction Brazing Machine.** Henry J. Burnett. *Tool Engineer,* v. 16, July '46, p. 46-47.

Two operators, one assembling and fluxing, and one operating machine, can do more than 2400 good quality brazed parts during an 8-hr. day. Compares with 175 good quality brazed parts by manual methods.

22-346 **Metallurgy of Aircraft Welding.** R. Smallman Tew. *Transactions of the Institute of Welding,* v. 9, April '46, p. 47-50.

Aircraft welding is not quite the straightforward matter that it might appear. Each phase of the subject requires the full attention of the most expert metallurgists and welding engineers, and a close alliance has to be maintained between the metallurgical properties of the metals and the corresponding properties of the welding processes.

22-347. **Plate Edge Preparation for Welding.** E. Seymour Semper and L. J. Hancock. *Transactions of the Institute of Welding,* v. 9, April '46, p. 54-60.

Latest developments in the technique of oxygen cutting and gouging. Importance of accuracy is stressed.

22-348. **Alco All-Welded Boilers.** *Railway Mechanical Engineer,* v. 120, July '46, p 339-343.

Welding, stress-relieving and inspection equipment installed and procedures established by the American Locomotive Co. at its Schenectady plant for the building of all-welded boilers.

22-349. **Plastic Bonded Light Alloys.** *Light Metals,* v. 9, July '46, p. 356-360.

Properties and uses of a new synthetic resin-base adhesive in which bonding may be achieved without application of external pressure. (Review from Prieswerk and von Zeerleder in *Schweizer Archiv,* v. 12, 1946, p. 113.)

22-350. **Welding Aluminum and Its Alloys.** *Canadian Metals & Metallurgical Industries,* v. 9, July '46, p. 29-32, 48.

Fundamental principles for welding aluminum sheet, plate and castings.

22-351. **Welding the Stainless Alloys in the "Shooting Star" Jet Engine.** W. J. Campbell. *Steel Processing,* v. 32, July '46, p. 431-435.

Precautions and steps necessary in the welding of stainless Type 347 alloys and Inconel. The atomic-hydrogen arc welding process was used, using hydrogen gas to back the joints.

22-352. **Factors Controlling the Strength of Brazed Joints From Final Report N.R.C. 560.** C. Rhyne, Jr. *Welding Journal,* v. 25, July '46, p. 599-611.

Experimental results on the strength of furnace-brazed joints with copper as the brazing metal. Particularly concerned with data that may be used in aircraft subassemblies. The parent metals are limited to S.A.E. 4130 and S.A.E. 1010 steels.

22-353. **Standard Welding Symbols.** *Welding Journal,* v. 25, July '46, p. 612-640.

This revision consists principally of an editorial rewording and rearrangement, intended to clarify the text and make it simpler for the average user to comprehend. Many illustrations have been added to provide specific examples of the use of the symbols under a wide variety of applications.

22-354. **Welding the Stainless Steels.** J. L. Filbert. *Welding Journal,* v. 25, July '46, p. 642-644.

While the same welding technique is used when welding all of the three different types of stainless steels (austenitic, ferritic, and martensitic), there is a decided difference in the reaction to the heat generated during welding by the steels of each of the three classifications.

22-355. **Application of Welding on the Railroads.** Leland E. Grant. *Welding Journal,* v. 25, July '46, p. 644-645.

Welding processes other than the oxy-acetylene method are now in use; the electric arc has displaced the gas torch to a very great extent and the submerged arc and methods of resistance welding are in daily use on the railroads. Applications range from the repair of small hand tools and other parts to the construction of cars and locomotives.

22-356. **Further Investigation of the Effect of Spot Welds on the Sheet Efficiency of Alclad 24S-T.** W. F. Hess, R. A. Wyant, and F. J. Winsor. *Welding Journal,* v. 25, July '46, p. 361s-375s.

An earlier report was limited to single-spot specimens in the 0.040-in. gage. This preliminary work has been expanded to include studies of multiple spot weld specimens as well as single spot weld specimens in the 0.020, 0.040 and 0.064-in. gages.

22-357. **A Review and Summary of Weldability Testing Carbon and Low Alloy Steels.** George G. Luther, Clarence E. Jackson, and Carl E. Hartbower. *Welding Journal,* v. 25, July '46, p. 376s-395s.

Review of weldability tests pertinent to ship hull construction. Specimen preparation, testing procedure and relative merits of 20 tests are considered either briefly or at length depending upon the degree of complexity of the test. 53 ref.

22-358. **The Water-Gas Reaction Applied to Welding-Arc Atmospheres.** Manley W. Mallett. *Welding Journal,* v. 25, July '46, p. 396s-399s.

Since, in most cases, the arc welding of steels entails the use of coated electrodes, the compositions and characteristics of the atmospheres generated from such coatings should likewise be of interest. Complete analyses of the atmosphere with a number of different coated electrodes were made. Approximate equilibrium conditions are obtained in the arc atmosphere, in spite of rapidity of the reaction. From an analysis of the gases in the arc atmosphere, one can deduce the conditions under which a weld pool solidified and, hence, can draw useful conclusions regarding the constituents of the weld metal, for example, the hydrogen content. 15 ref.

22-359. **The Spot Welding of Multiple Thicknesses of 0.040-in. Alclad 24 S-T.** W. F. Hess, R. A. Wyant, and F. J. Winsor. *Welding Journal,* v. 25, July '46, p. 413s-424s.

Conclusion of this work is that the spot welding of four thicknesses of 0.040-in. Alclad 24S-T should be carried out commercially only under very carefully controlled conditions.

22-360. **The Control of Distortion. Part III.** Orville T. Barnett. *Industry and Welding,* v. 19, July '46, p. 32-33.

Prevention of weld failures.

22-361. **High Capacity Equipment Ups Welding 30%.** Alan Bell. *Industry and Welding,* v. 19, July '46, p. 34-37.

Spot, arc, flash, gas and resistance welding all are represented.

22-362. **Reclaiming Cast Steel Car Couplers.** *Industry and Welding,* v. 19. July '46, p. 38-39, 58-59.

Some of these must have over $\frac{5}{16}$-in. buildup. Special positioners and techniques developed by the Erie Railroad make it possible in short order.

22-363 **Magnesium Welding Technique—a Commercially Successful Job.** *Industry and Welding,* v. 19, July '46, p. 40-42.

Because of fluidity of magnesium, all welding is done on special jigs and work is left in jigs until completely welded and cool

22-364. **Positioning Is Essential.** *Industry and Welding,* v. 19, July '46, p. 43, 80.

Setup using a standard 6000-lb. capacity positioner, electrically driven, set on a fabricated adapter frame and worked in conjunction with a tailstock.

22-365. **Lead Welding.** Robert L. Ziegfeld and David M. Borcina. *Steel,* v. 119, Aug. 5, '46, p. 120-122, 162, 165-166, 168.

Latest operator techniques for welding of lead to lead; how to make the most satisfactory types of joints; applications.

22-366. **Flash Welding the Light Alloys.** T. Watson and A. J. Hipperson. *Welding,* v. 14, June '46, p. 252-255.

Development of new type of machine for this purpose. Method employed differs widely from the usual flash welding process.

22-367. **Heavy Duty Arc Welding.** *Welding,* v. 14, June '46, p. 256-264.

Examples are given of the method in which arc welding is being applied in the construction of heavy excavating equipment. Welding procedures and means of assembling various units are explained.

22-368. **Brazing and Welding of Copper. Part I. Brazing.** Edwin Davis. *Welding,* v. 14, June '46, p. 265-280.

Properties of copper; types suitable for brazing; brazing materials; preparation of joints; various methods of brazing; applications of the process.

22-369. **Gas Turbines.** D. A. Oliver and G. T. Harris. *Welding,* v. 14, June '46, p. 281-285.

Work on flash butt welded disks and shafts; advantages and disadvantages of the welded construction.

22-370. **Resistance Welding.** *American Machinist,* v. 90, Aug. 1, '46, p. 121-124.

Describes what it is, how it works. (Based on motion picture film.)

22-371. **Resistance Welding With Storage-Battery Power.** *Machinery,* v. 52, Aug. '46, p. 167-170.

Development of the carbon-pile rheostat adaptable to routine resistance welding has made welding with storage-battery power practical in industry. (Condensation of paper by John D. Gordon before the American Society of Mechanical Engineers.)

22-372. **Welding Aluminum Railroad Tank Cars.** R. E. Haas. *Modern Metals,* v. 2, Aug. '46, p. 12-13.

Welding preformed 3S aluminum by the automatic carbon-arc process, with metallic aluminum electrodes.

22-373. **Pressure Welding Thin Aluminum Parts.** H. E. Linsley. *Iron Age,* v. 158, Aug. 8, '46, p. 56-60.

German method of simultaneously welding and forming thin-walled aluminum parts. Use of pressure welding for fabricating aircraft radiator fins and similar hollow components. (Correlation of a report published in *Aircraft Production (London),* and a recent publication of the T.I.I.C. Aeronautics Subcommittee.)

22-374. **Adhesives—Modern Tool of Fabrication.** D. L. Swayze. *S.A.E. Journal,* v. 54, Aug. '46, p. 412-417.

Application of high strength adhesives to the fabrication of automotive parts and assemblies. Design, tooling, and inspection; properties of adhesives; relative cost of chemical bonding compared with other methods of assembly. To benefit fully from the use of adhesives, parts must be designed so that loads applied to the bond are in shear or direct tension, eliminating peel and cleavage. Freedom of design is permitted by the wide variety of materials that can be bonded in all sorts of combinations.

22-375. **Defective Gray-Iron Castings.** *Metal Treatment,* v. 13, Summer '46, p. 108-110.

Recommended and standardized shop procedure for the repair of defective gray-iron castings intended for automotive use; four procedures are outlined, covering gas and arc welding, nickel welding (so-called "cold welding"), general nickel welding, and special repair conditions. (Reprinted from *Iron Age.*)

22-376. **The Hard-Zone or Underbead Cracking of Alloy Steels on Welding.** G. L. Hopkin. *Metal Treatment,* v. 13, Summer '46, p. 145-150.

A review of some recent literature. Critical hardness; austenitic electrodes; hydrogen in heat-affected zone; effect of microstresses; austenite stability; postheating; internal stress; hydrogen theory; retained austenite. 18 ref.

22-377. **The Metallurgy of Oxy-Acetylene Welding.** Phil Glanzer. *Tool Engineer,* v. 17, Aug. '46, p. 47-48.

Discusses the "little things" that make the difference between success and failure in flame welding.

22-378. **Brazing and Welding of Copper. Part II. Copper Welding.** Edwin Davis. *Welding,* v. 14, July '46, p. 300-312, 328.

A comprehensive and practical survey of the various methods of welding copper and the special techniques involved. Suitable joint design and preparation; applications.

22-379. **Boiler Tubing.** *Welding,* v. 14, July '46, p. 313-314.

Semiautomatic pressure welding of boiler tubes and some details of the equipment necessary. Continuous tubing in 95-ft. lengths has been successfully produced by this method.

22-380. **Metallurgy for Welders.** D. Llewellyn. *Welding,* v. 14, July '46, p. 315-320, 328.

Explains a simple method of taking sulphur prints enabling welder without laboratory to make sulphur prints and to find out something about the steel he has to weld; he will be able to trace any abnormal segregation that may be present in the plate adjacent to the parts that have to be fused during welding.

22-381. **Oxygen Cutting.** E. Seymour Semper. *Welding,* v. 14, July '46, p. 329-334.

Manual and machine methods.

22-382. **Properties of Lime Ferritic Electrodes.** Orville T. Barnett. *Steel,* v. 119, Aug. 19, '46, p. 96-97, 128, 130.

New electrode extends field of weldable steels to include high-carbon steels, carbon and alloy steel castings, enameling stock, cast iron and others.

22-383. **Brazing Tool Tips by Induction Heating.** *Steel,* v. 119, Aug. 19, '46, p. 101, 154.

Tungsten carbide tips are brazed to more than 200 types of cutting tools by use of induction process; method reduces cost of some jobs from $4.00 to $0.30 per hr.

22-384. **Welding Precious Metals.** F. W. Meyers. *Iron Age,* v. 158, Aug. 22, '46, p. 59-62.

Practical methods of welding gold, silver and platinum by the torch and by the hammer methods. Both pure metal and clad metal are covered.

22-385. **Portable Spot Weld Analyzer.** F. J. Haunty. *Welding Engineer,* v. 31, Aug. '46, p. 53-56.

Ingenious use of the cathode-ray oscillograph reproduces the current and pressure transients of a particular spot welder on the screen of the cathode-ray tube where they can be photographed for careful study.

22-386. **Welding Bulldozers on an Assembly Line. Part I.** Walter J. Brooking. *Welding Engineer,* v. 31, Aug. '46, p. 58, 60, 64, 66.

Plant and equipment at R. A. Le Tourneau, Inc.

22-387. **Applications of Lime Ferritic Electrodes. Part 2.** Orville T. Barnett. *Steel,* v. 119, Aug. 26, '46, p. 80-84, 86.

Discusses properties of lime-ferritic electrode deposits

through typical case histories. New electrode found to extend field of weldable steels to include those heretofore classified as "difficult to weld".

22-388. **Contact Arc Welding.** P. C. van der Willigen. *Philips Technical Review,* v. 8, June '46, p. 161-168.

A method of touch welding, whereby the arc is automatically ignited and if necessary reignited. This is achieved by transferring a large part of the metal from the core wire in the form of a fine powder to the originally insulating coating, which thereby becomes more or less conductive. The electrode can be kept resting on the workpiece right from the start and, during the welding, is continuously in contact with it both mechanically and electrically. With these contact electrodes welds can be made quicker and more reliably than with ordinary electrodes.

22-389. **Resistance Welding With Storage Battery Power.** John D. Gordon. *Steel Processing,* v. 32, Aug. '46, p. 497-501.

Development of storage-battery powered resistance welders to overcome inherent limitations of conventional welding processes especially when applied to aluminum and its alloys.

22-390. **The Atomic-Hydrogen Welding Process.** William P. Brotherton. *Steel Processing,* v. 32, Aug. '46, p. 511-514.

Processes involved in its application to light-gage metals. Atmosphere of hydrogen prevents the oxidation of either the metal being welded or the electrodes and accounts for the cleanness of the welds and the long life of the electrodes. Also precludes use of flux.

22-391. **Flash Welding Is Versatile.** C. B. Smith. *American Machinist,* v. 90, Aug. 29, '46, p. 94-97.

This process is often justified on limited quantities by savings in materials and subsequent machining.

22-392. **How to Bond Sapphire to Other Materials.** Melvin C. Cannon. *American Machinist,* v. 90, Aug. 29, '46, p. 129, 131.

Solder bonding and brazing described. Preparation for bonding; organic bonding materials; inorganic, nonmetallic cements; electroplating; shrinking and press fitting.

22-393. **The Spot Welding of Low Carbon Mild Steel Sheet.** W. S. Simmie. *Sheet Metal Industries,* v. 23, Aug. '46, p. 1573-1577.

Investigation carried out to determine the optimum values for *(a)* welding current, *(b)* pressure, *(c)* time of weld, and *(d)* forging time after welding, for the spot welding of 16 s.w.g. mild steel sheet. Material used was cold rolled, close annealed, openhearth sheet steel.

22-394. **The Pressure Weldability of Iron.** Hans Esser. *Sheet Metal Industries,* v. 23, Aug. '46, p. 1578-1583.

Investigation of pure pressure welding of iron test pieces. Apparatus; influence of temperature; influence of grain size; effect of pressure; surface preparation; carbon content. (Abridged translation of an article from *Archiv fur das Eisenhüttenwesen,* v. 4, p. 199-256.)

22-395. **The Welding of Nonferrous Metals. Part VII.** E. G. West. *Sheet Metal Industries,* v. 23, Aug. '46, p. 1584-1587.

Welding of magnesium alloys.

22-396. **Plastic Bonding of Light Metals.** E. Preiswerk and A. von Zeerleder. *Plastics,* v. 10, July '46, p. 357-360.

Describes properties of Araldit, a new medium which may be brushed onto the surfaces to be joined, which are preheated to about 100° C. By heating to 120 to 220° C. the resin hardens without application of pressure and adheres to the metal surface. (Abstracted from *Schweizer Archiv,* v. 12, 1946, p. 113.)

22-397. **Heliarc Welding Aluminum.** Gilbert C. Close. *Light Metal Age,* v. 4, Aug. '46, p. 12-14.

Consisent and superior welding results are being obtained in practice at one plant from application of this method to aluminum alloys.

22-398. **Controlling Distortion.** William F. Dawson. *Steel,* v. 119, Sept. 2, '46, p. 100-101, 150.

System of control developed by Navy welding engineers in joining sections of huge steel floating dry docks reduces excessive distortion to a minimum.

22-399. **Welding Methods for Alloy Steel Piping.** Eric R. Seabloom. *Welding Engineer,* v. 31, Sept. '46, p. 31-36.

First in a series of four articles on welding of steels for high-temperature use or corrosion resistance; covers the chromium-molybdenum steels with ½ to 10% chromium. Oxy-acetylene, metal-arc and atomic-hydrogen welding; use of stainless electrodes; preheating; postweld heat treatment; stress relieving; radiographic inspection.

22-400. **Hard Facing, Antidote for Wear.** Fred M. Burt. *Welding Engineer,* v. 31, Sept. '46, p. 37-41.

Fundamental facts of what hard facing will do to extend the service lives of parts subjected to abrasion and impact. Petroleum industry; hard faced tool joints; roller guides for a steel mill; worn engine valves; dies and punches; teeth for ditch diggers.

22-401. **Radiant Heating at Kankakee.** Clyde B. Clason. *Welding Engineer,* v. 31, Sept. '46, p. 42-43, 60.

A pioneer installation that includes 40 miles of wrought iron pipe and 25,000 ft. of copper tubing to be joined to make a radiant heating system for a new plant.

22-402. **Servel Gas Welds Gas Refrigerators.** Gerald Eldridge Stedman. *Welding Engineer,* v. 31, Sept. '46, p. 44-48.

Plant and equipment; extensive conveyerized production lines for oxy-acetylene welding.

22-403. **Welding Bulldozers on an Assembly Line. Part 2.** Walter J. Brooking. *Welding Engineer,* v. 31, Sept. '46, p. 49-51, 56.

Additional welding details; describes special machines that were built for machining, flame cutting and flame hardening operations.

22-404. **Seam Welding Turbojet Elbow.** Frank G. Harkins. *Welding Engineer,* v. 31, Sept. '46, p. 52-55.

Application of seam welding to the inner elbow of the I-16 jet engine reduced fabrication time from 19.4 min. to 75 sec. per part and entirely eliminated rejections due to warpage.

22-405. **Welding Jet Engine Parts.** W. J. Campbell. *Iron Age,* v. 158, Sept. 5, '46, p. 46-49.

Procedure and fixtures employed in welding Inconel and type 347 stainless used for aircraft gas-turbine parts. Overcoming crater cracking and cracking due to clamping; data on surface preparation and welding machine settings.

22-406. **Welding Makes Damaged Truck Wheels Stronger.** *Industry and Welding,* v. 19, Aug. '46, p. 42-43, 76.

Total cost of repairing wheels by welding is one-fifth the replacement cost.

22-407. **Strong Machinable Arc Welds on Cast Iron.** *Industry and Welding,* v. 19, Aug. '46, p. 44-45.

High-nickel arc welding electrodes offer desirable deposits for salvaging cracked or worn castings, or for the repair of blowholes and machining errors.

22-408. **Projection and Spot Welding on the Double.** Arnold J. Freiheit. *Industry and Welding,* v. 19, Aug. '46, p. 48-49.

How a high-production stamping plant adapted its spot welding machines to do double duty, saving time and money.

22-409. **Are You Welding Steel Beams and Angles?** Wilburn L. Gibbons. *Industry and Welding,* v. 19, Aug. '46, p. 55, 64.

Tests show same safety factor as other methods for welded construction of trusses and beams for new all-steel buildings.

22-410. **Resistance Welding With Storage-Battery Power.** John D. Gordon. *Mechanical Engineering,* v. 68, Sept. '46, p. 797-801.

Reduced costs and freedom from voltage fluctuations are advantages. Group of six welders at Aluminum Goods Mfg. Co. was used for assembly welding containers for rocket bodies. Material was 0.081-in. 3S aluminum. Estimated cost of condenser-discharge welding installations was 40% more than the battery type.

22-411. **Mild Steel to Cast Iron; Resistance Welded by a Special Method.** E. W. Harding. *Welding,* v. 14, Aug. '46, p. 356-359.

Detailed account of an ingenious method whereby a practical production problem was solved by resistance welding a steel strip to a casting.

22-412. **Oxygen Cutting; Manual and Machine Methods.** E. Seymour Semper. *Welding,* v. 14, Aug. '46, p. 360-364.

Latest type of equipment and technique; appropriate operating data.

22-413. **Single Operator Transformers; Three-Phase Versus Single-Phase Connection.** C. A. Kershaw. *Welding,* v. 14, Aug. '46, p. 365-369.

Discussion of the merits of three-phase and single-

phase connections to single arc welding transformers from the point of view of the users of welding equipment. As the alternative to the complicated three-phase connection to the transformer and increased cost, suggests that the primary can be connected to two lines with a suitable condenser placed across it to reduce the primary line current.

22-414. **Cyc-Arc Stud Welding; Method and Applications.** *Welding,* v. 14, Aug. '46, p. 371-374.

Outline of main features of the Cyc-Arc stud welding equipment and process. Possibilities for automatic stud welding cover a wide field and recently there has been progress in nonferrous applications.

22-415. **Prefabricated Houses: Welding and the Temporary Housing Program.** Leonard W. Elliott. *Welding,* v. 14, Aug. '46, p. 350-355.

How welded components are being employed in various types of dwellings.

22-416. **Pressure Welding.** H. Seymour. *Petroleum,* v. 9, Aug. '46, p. 180, 187.

Applications to rails, pipe lines and boiler tubes.

22-417. **Theory and Practice of Glass-Metal Seals. Part II.** A. M. Monack. *Glass Industry,* v. 27, Sept. '46, p. 446-449, 464, 466, 468, 470, 476.

Table gives properties of most of the metals and alloys which are suitable for sealing to glass. General requirements are listed and technique, applications, advantages and disadvantages of each metal or alloy are described.

22-418. **Arc Welding Cast Iron.** *Steel,* v. 119, Sept. 9, '46, p. 128.

Nickel electrode reduces need for special treatment of casting before and after welding.

22-419. **Air Power in Production of Bimetal Brake Linings.** *Compressed Air Magazine,* v. 51, Sept. '46, p. 244-247.

Method used for bonding powdered metal to backing plates, using heat and pressure.

22-420. **Well-Planned Tooling Makes Sound Flash Welds.** C. B. Smith. *American Machinist,* v. 90, Sept. 12, '46, p. 127-130.

Welding technique is described for simple tubing, end fittings, and as-forged sections using standard clamping dies, mandrels and tables.

22-421. **The Selection of Welding Processes.** W. J. Campbell. *Welding Journal,* v. 25, Aug. '46, p. 704-706.

In designing welded equipment, designer should consider available welding processes, weldability of material, types of joints, accessibility of joints, cleaning of joints, and proper sequence of operations to minimize distortion.

22-422. **Fusion Welding of Sheet Metal.** J. M. Diebold. *Welding Journal,* v. 25, Aug. '46, p. 724-732.

Advantages and disadvantages of the various types of fusion welding; gas, atomic-hydrogen, inert gas (heliarc), submerged melt, carbon-arc, automatic arc and manual arc welding. Details of experience with manual arc welding in manufacture of amphibious truck.

22-423. **Steel House Construction.** Alfred Fetz. *Welding Journal,* v. 25, Aug. '46, p. 733-737.

Design details of new type of housing in which welding replaces nailing.

22-424. **Poke Welding of Stainless Steel Cold Storage Sheathing.** R. K. Waldvogel. *Welding Journal,* v. 25, Aug. '46, p. 738-744.

Results of experiments on poke welding for joining side and ceiling sheathing in cold storage rooms show a 10% reduction in time of erection with no additional cost and more durable joints when compared with bolting and soldering.

22-425. **Streamlined Hard Facing by the "Spray-Weld" and "Powder-Weld" Processes.** C. J. Long and T. E. Rich. *Welding Journal,* v. 25, Aug. '46, p. 744-745.

Method uses Colmonoy No. 6 hard facing alloy. With the Powder-Weld process the alloy is sprayed in powder form through a newly developed powder metallizing unit. With the Spray-Weld process a special plastic bonded rod is used. Details of process, its advantages and limitations.

22-426. **Effect of Metallurgical Changes Due to Welding Upon the Fatigue Strength of Carbon Steel Plates. Progress Report No. 1 and No. 3.** *Welding Journal,* v. 25, Aug. '46, p. 425s-450s.

Results of a test made on a large number of specimens prepared with various welding techniques are presented by means of tables, graphs, micrographs, and discussion.

22-427. **Residual Stresses in Intersecting Butt Welds.** E. Paul DeGarmo, J. L. Meriam, and Finn Jonassen. *Welding Journal,* v. 25, Aug. '46, p. 451s-462s.

Studies were made of the residual stresses in deck panels of C-4 troop transports. Deals with the six preliminary panels, 6 ft.x$\frac{31}{32}$ in., and five XJA deck panels which were investigated. Details of the preparation and welding of the panels are shown. Test results are shown graphically and conclusions are drawn.

22-428. **Investigation of Failures in a Welded Bridge.** H. Busch and W. Reuleke. *Welding Journal,* v. 25, Aug. '46, p. 463s-466s.

Tests used to determine reasons for failures of three bridges in Belgium. Main causes believed to be: multiaxial state of restraint produced by welding stresses and unfavorable weld distribution, low ambient temperature and low notch impact characteristics of the steel used. (Abstracted from *Stahl und Eisen,* v. 62, Jan. 22, '42, p. 66, by D. Rosenthal.)

22-429. **The Spot Welding of Ten Aluminum Alloys in the 0.040-In. Gage.** W. F. Hess, R. A. Wyant, and F. J. Winsor. *Welding Journal,* v. 25, Aug. '46, p. 467s-484s.

Describes an investigation of the spot welding characteristics of the newer aluminum alloys, R301-T, XB75S-T (bare and alclad), alclad 24S-T81 and the older alloys 24S-T (bare and alclad), 3S-1/2H, extruded 14S-T, 52S-1/2H and 61S-T in the 0.040-in. gage. 23 ref.

22-430. **The Effect of Weld Length Upon the Residual Stresses of Unrestrained Butt Welds.** E. Paul DeGarmo, J.

L. Meriam and Finn Jonassen. *Welding Journal,* v. 25, Aug. '46, p. 485s-487s.

Accurate determination of this relationship was desirable since, if various specimens were to be studied to determine the effect of several variables upon the residual welding stresses, it was necessary to know the minimum specimen length which could be used and still be assured that maximum possible stresses would be obtained. Results indicate that test specimens should be at least 20 in. long.

22-431. **German Arc Welding Electrodes.** Boyd E. Cass. *Foote Prints,* v. 18, '46, p. 14-15.

Reviews data pertaining to German welding electrodes as manufactured by two of the major producers.

22-432. **Honeycomb Core Structures.** O. S. Tuttle and W. B. Kennedy. *Modern Plastics,* v. 24, Sept. '46, p. 129-134, 194, 196.

The honeycomb sandwich, which is made of resin impregnated sheet material which has been cured and assembled in the form of nested hexagonal cells is the most efficient structure yet developed for lightly loaded panels. Physical properties of a few promising types are tabulated. Test methods and results of accelerated weathering, water immersion, fatigue, shear strength, and compressive strength tests. Panels tested consisted of 24S-T alclad plates with ½-in. thick honeycomb.

22-433. **Cast Iron Repair Welding; Metallurgical Aspects.** J. M. Diebold, J. A. Blastic, and J. A. Griffin. *American Foundryman,* v. 10, Sept. '46, p. 49-62.

Test program for the purpose of establishing the limitations of cast iron welding and developing welding procedures which will produce desired physical properties in welds and heat-affected zones. Scope of the study limited to the welding of gray cast iron by use of cast iron, nickel, or monel filler metal, and further limited in respect to compositions of materials.

22-434. **Flame Cutting and Welding in Bulldozer Manufacture.** H. H. Washbond and O. F. Wilkinson. *Iron Age,* v. 158, Sept. 12, '46, p. 56-59.

Use of flame cutting and weld fabricating methods in the construction of bulldozers and other heavy road machinery. Reasons for the adoption of this fabricating method.

22-435. **Gantry Aids Welded Tank Production.** *Iron Age,* v. 158, Sept. 12, '46, p. 70-71.

Use of a specially designed gantry carrying an automatic arc welding unit to weld seams and heads of butane and propane tanks. Types of electrodes used, amperage, voltage and location of manual sealing beads.

22-436. **Heliarc Welding—A Newly Developed Arc Welding Process.** *Machinery,* v. 53, Sept. '46, p. 166-171.

Investigation of shielding gases; torch design for heliarc welding; applications of the process in production; stainless steel production applications; stainless steel tube welding; aluminum welding applications.

22-437. **Automatic Welding Process.** R. H. Newton. *Steel,* v. 119, Sept. 16, '46, p. 108, 110.

Lincolnweld process of automatic metallic arc welding reduces boiler and tank fabrication costs by as much as 25%.

22-438. **Economical Method of Flame Cutting Cast Iron.** *Steel,* v. 119, Sept. 16, '46, p. 115-116.

Technique recommended by engineers of National Cylinder Gas Co.

22-439. **Glass Techniques in Tube Manufacture.** Victor E. DeLucia and Warren J. Ramler. *Radio News,* v. 36, Sept. '46, p. 11-13, 30-31.

Techniques for making various kinds of glass-to-metal seals and methods of detecting leaks in vacuum systems.

22-440. **Hard Surfacing Machine Parts by Welding Increases Their Life 3 to 30 Times.** C. J. Long and T. C. Rich. *Brick & Clay Record,* v. 109, Sept. '46, p. 62, 64.

Describes process and tabulates uses of hard facing alloys in brick and tile machinery.

22-441. **Pressure Welding's Flexibility Solves Alloy Pipe Problems.** E. P. Jones. *Oil and Gas Journal,* v. 45, Sept. 21, '46, p. 238, 241, 244, 246, 249.

Because of shortage of standard pipe, surplus material in the form of alloy aerial bomb tubing, rocket bomb tubing, etc. has been used. Pressure welding was shown by tests to give satisfactory results. Technique is described.

22-442. **Original Resistance Welder Design for Production of U. S. Navy 40-Mm. Ammunition Boxes.** F. M. Pence. *Welding Journal,* v. 25, Sept. '46, p. 824-828.

Description of equipment used at Thermador Electrical Mfg. Co.

22-443. **Variation in Quality of Spot Welds in Low-Carbon Steel Over a Range of Welding Variables.** J. J. Riley. *Welding Journal,* v. 25, Sept. '46, p. 833-842.

Welding was carried out under controlled conditions which could easily be duplicated in production. For each setting of electrode force and steel thickness a run of approximately 135 welds was made. After every 20 welds, one weld was selected for metallurgical sectioning and etching. A multiple weld specimen was made for each welding setup to determine the degree of current shunting between welds. Investigation was confined to thicknesses of 0.032, 0.060, 0.090 and 0.120 in. Tensile shear strength loads for the various welding setups are plotted as frequency distribution charts.

22-444. **Projection Welding Push Rod.** E. B. Rhodes. *Welding Journal,* v. 25, Sept. '46, p. 842-843.

Describes equipment developed for production of a good weld between S.A.E.4140 bar stock and S.A.E.1020 steel plate, by a combination welding and postheat annealing arrangement. Product is an airbrake part.

22-445. **Limited-Input Arc Welders.** E. Steinert. *Welding Journal,* v. 25, Sept. '46, p. 844-847.

Characteristics and applications of type of welder suitable for small shops.

22-446. **Causes and Prevention of Defects in Welding.** Frederick S. Dever. *Welding Journal,* v. 25, Sept. '46, p. 860-864.

Discusses each type of defect found in arc welding, gas welding, atomic-hydrogen welding, and spot welding, giving possible causes and remedies.

22-447. **Reduction of Residual Welding Stresses by the Use of Austenitic Electrode.** Finn Jonassen, J. L. Meriam, and E. Paul DeGarmo. *Welding Journal,* v. 25, Sept. '46, p. 489s-491s.

Several test panels of low-carbon, ship quality steel plates 1 in. thick were made using austenitic electrodes and the resulting residual welding stresses compared with those of similar panels made with Type E6010 and E6012 electrodes. Longitudinal residual welding stresses using austenitic electrodes are less than when ordinary ferritic (Type E6012) electrodes were used. Reduction is not sufficient to justify the use of such electrodes for this purpose.

22-448. **Effect of Certain Block and Other Special Welding Procedures on Residual Welding Stresses.** Finn Jonassen, J. L. Meriam, and E. Paul DeGarmo. *Welding Journal,* v. 25, Sept. '46, p. 492s-496s.

Longitudinal residual welding stresses in butt welds between 1-in. thick plates can be kept below 35,000 psi. by using block welding procedure described. Also evaluates "wandering" block and cascade procedures. Results shown graphically.

22-449. **Cooling and Heating Rates of Plates, Cylinders, and Spheres.** Victor Paschkis. *Welding Journal,* v. 25, Sept. '46, p. 497s-502s.

Influence of cooling on properties of welded steel. Charts for rates of heating and cooling, the charts being drawn in dimensionless units and therefore generally applicable. Complete set of charts is given, and their use illustrated by examples.

22-450. **Progress Report on the Spot Welding of High-Tensile Carbon and Low-Alloy Steels.** W. F. Hess, W. D. Doty, and W. J. Childs. *Welding Journal,* v. 25, Sept. '46, p. 503s-509s.

First part describes experimental work and gives indicated optimum conditions for the spot welding of N.E.8715 in the 0.018-in. thickness, and N.E.8630 and S.A.E.4340 in the 0.031-in. thickness. Deals with an investigation of the effect of cold rolling and various types of heat treatment on the spot weld properties of steel. Welds were made in steel having five different prior treatments and these welds tested for normal tension, shear and shear impact strengths.

22-451. **The Effect of Periods of Rest on the Fatigue Strength of Welded Joints.** *Welding Journal,* v. 25, Sept. '46, p. 518s-521s.

Experiments indicate that rest periods have no significant effect upon the fatigue strength of welded joints in a steel slightly softer than the standard grade for bridges and buildings. When these joints are made and tested

under conditions approximating those met in general structural work, conclusions may then be extended to welded joints in steel of the standard grade for bridges and buildings.

22-452. **The Problem of Fracture. The Failure of Welded Steel Structures and Recommended Research.** John H. Hollomon. *Welding Journal,* v. 25, Sept. '46, p. 534s-583s.

Attempts to interpret knowledge of fracture in terms of consistent theory. Where there are divergencies in knowledge, and where theory is adequate, an attempt is made to indicate the direction of research to resolve the difficulty. Coordinates approaches of the mechanical engineer, the metallurgist, and the physicist, and welds the knowledge gained from them. 126 ref.

22-453. **Crack Sensitivity of Chromium-Nickel Stainless Weld Metal.** R. David Thomas, Jr. *Metal Progress,* v. 50, Sept. '46, p. 474-479.

Weld metal cracks occur at elevated temperatures and are caused by shrinkage stresses developed on solidification and cooling. Partially ferritic weld metals are less crack susceptible than the fully austenitic compositions. Certain residual elements greatly increase the susceptibility. Titania type coatings are more likely to produce cracks in susceptible alloys than the lime type coating. Cracks may arise from changes in composition of the weld metal by dilution from a dissimilar base metal.

22-454. **Jubilant Welding.** J. H. Gillett. *Welder,* v. 15, April-June '46, p. 25-26, 30.

Six salient examples of metallic arc welding on the Jubilant 12-ton chassis.

22-455. **The Production of Gun Carriages.** *Welder,* v. 15, April-June '46, p. 27-30.

Manufacture of carriages for the 40-mm. quick-firing anti-aircraft gun. Importance of jig welding technique which made for increased output.

22-456. **The Welding of Revlac-Tipped Tools.** *Welder,* v. 15, April-June '46, p. 31-33.

Distinguishing feature of Revlac-tipped tool is that tip material is deposited from electrodes by an electric welding process. Preparation, welding and aftertreatment. The shanks are prepared in much the same manner as for other tipped tools, and a typical example of a shank ready for tipping is shown.

22-457. **Mulberry Pierheads.** *Welder,* v 15, April-June '46, p. 34-39.

Detailed description of this enormous project and the large part played by electric arc welding in the construction.

22-458. **Spotlight on Arc Welding. 1—Vauxhall Motors, Ltd., Luton, Beds.** *Welder,* v. 15, April-June '46, p. 40-42.

Electric welding is used in the manufacture of all the company's vehicles, built for both commercial and private use. Welding department is not only concerned with the part to be welded and the actual welding operation but is also responsible for the manufacture of a large amount

of the welding plant employed in the works, and also in the maintenance of such plant. Illustrations fully show extent to which arc welding is used.

22-459. **Combined Welding and Riveting in Structures.** R. G. Braithwaite. *Welder,* v. 15, April-June '46, p. 43-47.

Combinations of shop welding and site riveting or bolting are exemplified in illustrations in connection with various contracts embracing thousands of tons of bridging equipment.

22-460. **Effects of Moisture in Electrode Coatings.** J. B. Arthur. *Iron Age,* v. 158, Sept. 19, '46, p. 58.

Note gives results of 7000 tests on A.W.S. class 6000 electrodes.

22-461. **Thermit Welding in Steel Plant Maintenance.** J. H. Deppeler. *Iron and Steel Engineer,* v. 23, Sept. '46, p. 55-62; discussion p. 67.

General procedure in making a thermit weld; properties and tests of thermit welds. Three principal jobs for this welding process in steel mills are in repair of broken parts, building up worn parts, manufacture of new constructions. Examples of each given.

22-462. **Protecting Mill Equipment With Hard Facing.** G. E. Wilson. *Iron and Steel Engineer,* v. 23, Sept. '46, p. 63-67; discussion p. 66.

Applications to blooming mill hot shear blades; horizontal-twist guide rolls; dies and shafts.

22-463. **Braze Welding Damper Windings.** Glenn Stangland. *Steel,* v. 119, Sept. 23, '46, p. 104-105, 170, 172.

Steps and principles used in joining damper windings to insure permanence of electrical characteristics in large synchronous motors and generators which must start with high torque loads.

22-464. **Profitable Application of Atomic-Hydrogen Welding.** Claud E. Coppock. *Production Engineering & Management,* v. 18, Sept. '46, p. 56-59.

Cost of stainless steel seam welding has been reduced from eleven cents to five cents per linear foot at Ryan Aeronautical by replacing other processes with atomic-hydrogen hand-held torch welding. Speeds of 28 in. per minute are being obtained with shop-built, automatic feed welding units.

22-465. **Photoelectric Controlled Welding.** *Steel,* v. 119, Sept. 30, '46, p. 72.

Multiple spot welding of railroad car stiffeners is expected to increase production 3000%.

22-466. **Use of Bronze Welding in Repairing a Draw Bench Cylinder.** *Steel,* v. 119, Sept. 30, '46, p. 82, 105.

Bronze welding an 8½-ft. crack in the main cylinder of a 280-ton draw bench.

22-467. **Future Ships—Will They Be All-Welded?** J. L. Adam and C. S. Lillicrap. *Transactions of the Institute of Welding,* v. 9, June '46, p. 84-86.

Something in the nature of a compromise in welding and riveting in ship construction, for the immediate fu-

ture at least, was the inference to be gathered from a discussion at a meeting of the Institute of Welding in London.

22-468. **Welding Tank Armor and High Tensile Steels.** R. J. Fowler and L. F. Denaro. *Transactions of the Institute of Welding,* v. 9, June '46, p. 87-93.

Important tank welding developments which took place during the recent war. Development of tests and standards; armor composition and weldability; welding light armor with austenitic electrodes; welding heavy armor; weldability related to plate composition; austenitic electrodes; hygroscopic moisture in electrode coatings. Includes graphs and tables. 35 ref.

22-469. **Symposium on Metallurgy of Steel Welding. Report of Discussion.** *Transactions of the Institute of Welding,* v. 9, June '46, p. 103-112.

First part of a report on the discussions at the Symposium on Metallurgy of Steel Welding held by the British Welding Research Association. Weldability test; rate of cooling; hydrogen in weld metal; hardened zone cracking; macrostructure of weld deposits; hardening of mild steel; sulphur limits; oxide inclusions.

22-470. **Welding at Low Temperatures.** *Western Machinery and Steel World,* v. 37, Sept. '46, p. 120-121.

Tremendous advantage claimed for electric process is in the lower temperatures involved. Where warpage, changes in grain size, and the introduction of heat stresses must be avoided, process has meant the difference between success and failure.

22-471. **Superior Tank & Construction Co. of Los Angeles Leads the Way in Fabricating Metal Spheres.** *Western Metals,* v. 4, Sept. '46, p. 41-43.

How metal spheres used for storage of liquified petroleum gases are fabricated.

22-472. **Welding Speeds Prefabrication of Lintels for Aircraft Hangars.** R. P. Sharer. *Steel Processing,* v. 32, Sept. '46, p. 585-586.

Lintels for airplane hangars are produced by the thousands with this modern automatic metallic-arc welding process. Welding occurs on the reinforcing plates, with each seam involving only 15 in. of welding or a total of 60 in. on each lintel. Each 15-in. weld is completed in about 15 sec., using $\frac{5}{32}$-in. bare wire electrode with standard grade flux.

22-473. **Stainless Steel Trailer Operation.** Joseph Geschelin. *Automotive and Aviation Industries,* v. 95, Oct. 1, '46, p. 34-36, 77.

Welding equipment and procedures of assembly at Fruehauf Trailer Co.

22-474. **Manufacture of Welding Electrodes.** *Machinery (London),* v. 69, Aug. 22, '46, p. 231-234.

Production-line methods giving an output of over 1000 lb. per hr.

22-475. **Welding Stainless Steels.** J. A. McWilliam. *Aircraft Production,* v. 8, Sept. '46, p. 429-431.

Review of some successful methods. Table shows various compositions of corrosion resisting steels.

22-476. **Hornet Engine Mounting.** *Aircraft Production,* v. 8, Sept. '46, p. 444-449.

Engine mounting of the de Havilland Hornet, which is a variant of the conventional welded tubular structure usually adopted on British aircraft, has been thoroughly tooled for manufacture to close limits for reasons of interchangeability. Methods of fabrication described.

22-477. **Pressure Welding.** *Aircraft Production,* v. 8, Sept. '46, p. 450-451.

Further notes on the German method of forming engine aftercooler elements.

22-478. **How to Pressure Weld Hollow Parts.** *American Machinist,* v. 90, Oct. 10, '46, p. 110-112.

German process described has been developed for aluminum alloy cooler parts and employs alloy steel dies with integral welding "teeth".

22-479. **Firecracker Production Welding.** E. J. Birkbeck. *Welding,* v. 14, Sept. '46, p. 396-402.

Process and special equipment developed.

22-480. **Oxygen Cutting. Part III.** E. Seymour Semper. *Welding,* v. 14, Sept. '46, p. 403-410.

Drives and templets for profiling machines and speed control.

22-481. **Vehicle Welding Repairs.** *Welding,* v. 14, Sept. '46, p. 411-417.

Some typical examples of the work and the procedures adopted.

22-482. **Electrode Holders for High Current Arc Welding.** D. M. Kerr. *Welding,* v. 14, Sept. '46, p. 418-420.

Details of a holder which has been specially developed for work in shipyards.

22-483. **Increasing Arc Welded Production.** R. L. Swan. *Welding,* v. 14, Sept. '46, p. 421-425; discussion, p. 425-426.

Design, manipulators and shop lay-out. (Condensed version of a paper presented at the Welding Conference, held by the Institution of Production Engineers.)

22-484. **Bonding of Rubber to Ferrous Metals by Brass Plating. Tabulated Analysis of Proposed Practice.** T. H. Messenger. *Journal of Rubber Research,* v. 24, Sept. '46, p. 181-188.

The literature is reviewed by a tabulation method, thus permitting easy comparison. 53 ref.

22-485. **Welding Speeds Frame Production.** *Industry and Welding,* v. 21, Sept. '46, p. 42-43.

Spot and arc welding are rapidly replacing rivets in auto frames.

22-486. **Welding 5% Chromium Steel.** Robert T. Pursell. *Industry and Welding,* v. 21, Sept. '46, p. 44-45.

Joint preparation; filler metal; preheating temperature; heat treating temperature; cooling rate.

22-487. **Magnesium Welding Leads to Ladder Production.** M. M. Moyle. *Modern Metals,* v. 2, Oct. '46, p. 11-14.

Manufacture of magnesium ladders by improved welding process.

22-488. **Welding Propane Gas Tanks.** Fred M. Burt. *Welding Engineer,* v. 31, Oct. '46, p. 39-41.

How to make a perfect sphere from flat sections.

22-489. **Welding Methods for Alloy Steel Piping. Part II.** Eric R. Seabloom. *Welding Engineer,* v. 31, Oct. '46, p. 44-49.

Characteristics of various ranges of straight chromium steels, with chromium contents ranging from 10 to 30%; welding procedures and techniques.

22-490. **Welded Aluminum "Blitz" Cans.** A. B. Carlson. *Welding Engineer,* v. 31, Oct. '46, p. 57-59.

Combination of spot and seam welding provides U.S. Marines with watertight, corrosionproof cans for the storage and transportation of liquid foods.

22-491. **Induction-Brazed Kitchen Tools.** L. Gise and J. R. Stewart. *Welding Engineer,* v. 31, Oct. '46, p. 60.

Applied to the brazing of stainless steel kitchen utensils, induction heating has increased production, reduced labor costs and improved quality.

22-492. **Tooling for Arc Welded Production.** Walter J. Brooking. *Tool Engineer,* v. 17, Oct. '46, p. 18-27.

General analysis of the operations and functions which must be performed in the production of welded equipment, either on a mass production or job shop operation scale.

22-493. **All-Welded Floating Drydock.** *Welding Engineer,* v. 31, Oct. '46, p. 54-56.

The ARD-33 giant ship-lifting drydock, with a lifting capacity of 6000 tons and to be used for major ship repairs, contains over 73 miles of welding.

22-494. **Well-Planned Tooling Makes Sound Flash Welds.** C. B. Smith. *American Machinist,* v. 90, Sept. 26, '46, p. 114-116.

Further examples of flash welded components are illustrated together with the setups for fabricating them efficiently.

22-495. **Synthetic Insulation Stripped Faster From Fine Copper Leads.** Victor Canziani. *American Machinist,* v. 90, Sept. 26, '46, p. 135-138.

Ends of the wire are dipped for a few seconds in one chemical solution, followed immediately by a quick dip in a second solution that acts as an accelerator. Then, by gently stroking softened portion of insulation with two fingers, it is stripped from wire with one or two strokes, leaving a bright, clean lead end which can be tinned at low temperature. Chemicals have no effect on the wire itself, do not affect tinning and only one chemical bath is operated at temperature approaching 500° F.

22-496. **Welding, Flame Cutting for Efficient Maintenance and Low Cost.** A. D. Stout, Jr. *Coal Age,* v. 51, Sept. '46, p. 94-98.

Modern welding and flame cutting equipment lends itself to repair, rebuilding and fabrication of mining equipment. Discusses its use in the maintenance of electrical equipment.

22-497. **Mineral Constituents of Arc Welding Slags.** R. C. Vickery. *Metallurgia,* v. 34, Aug. '46, p. 177-180.

Study is made of the reactions at high temperatures of the major constituents of arc welding electrode coatings, namely, FeO, MnO, TiO_2, and SiO_2. Experimental procedures were such as to closely approach the conditions of slag formation during welding, and the samples of slag thus obtained were examined petrographically. Sequence is suggested for the interaction of the electrode coating constituents, and observations are made on the practical applications of the findings.

22-498. **Shrinkages and Deformations of Welds.** F. Guyot. *Engineers' Digest (American Edition),* v. 3, Aug. '46, p. 407-410.

Transverse shrinkage in butt welding of bars and plates; the various influencing factors. Longitudinal shrinkage also considered briefly. Experimental data shown graphically. (Abstracted from *Arcos,* no. 100, Jan. '46, p. 2357-2380.)

22-499. **The Spot Welding of Mild Steel Sheet of Varying Carbon Content.** W. S. Simmie. *Sheet Metal Industries,* v. 23, Sept. '46, p. 1777-1784.

Welding conditions necessary for spot welding 16 s. w. g. mild steel sheets of varying carbon contents. As Vickers hardness values in excess of 350 were anticipated, a series of tests was carried out in connection with the heat treatment of spot welds by the application of a postheating current immediately after welding.

22-500. **The Welding of Magnesium Alloys. (Continued.)** E. G. West. *Sheet Metal Industries,* v. 23, Sept. '46, p. 1785-1791.

An account of resistance welding. Some interesting photographs of gas welds are included. 12 ref.

22-501. **Glass-to-Metal Seal Design.** W. J. Scott. *Journal of Scientific Instruments,* v. 23, Sept. '46, p. 193-202.

History; theory of formation of oxide interlayers; effect of glass composition on color of the seal, and the properties of seals made with different metals are tabulated. Cemented seals with deformable interlayers; physical properties of sealing glasses and metals; relative thermal contraction of glass and metal; and basic parts and their stress systems. 43 ref.

22-502. **Welding in Airline Practice.** J. R. Morrill. *Aero Digest,* v. 53, Sept. '46, p. 55.

A few examples of welded items which represent some of the important innovations in product design that are helping meet the increasing need for better accommodations in air travel.

22-503. **The Strength and Safety of Welded Joints.** M. Ros. *Engineers' Digest (American Edition),* v. 3, Sept. '46, p. 433-435.

Theory and experimental results relative to the strength of various types of welds. The tests were carried out at the Zurich Testing Laboratories from 1943 to 1945. Progress from 1930 to 1945 in mechanical properties of welds is shown graphically. (Condensed from *Schweizer Archiv,* v. 12, Jan., Feb., and March '46, p. 1-12, 48-63, and 73-92, respectively.)

22-504. **Reclaiming Locomotive Parts by Welding.** *Railway Mechanical Engineer,* v. 120, Oct. '46, p. 529-531; discussion p. 531-532.

Report presented at Locomotive Maintenance Officers' Association meeting discusses method, techniques, applications to various parts.

22-505. **Investigation of End Cracking.** A. T. Westbrook. *Railway Mechanical Engineer,* v. 120, Oct. '46, p. 563.

Results of an investigation on the end cracking of superheater flues welded to the tube sheet and dealing particularly with the relation between the welding and the propagation of cracks. (Presented at meeting of Master Boiler Makers' Association.)

22-506. **The Application of Series Capacitors to Flash Welders.** James F. Deffenbaugh. *Electrical Engineering,* v. 65, Oct. '46, p. 686-689.

Welding operation is composed of two phases which differ widely in both power factor and kilovolt-ampere demand. First phase is termed flashing and occurs when the pieces to be welded are brought in contact. When the plastic temperature has been reached, the upset phase takes place. Shows oscillograms and vector diagrams of current and voltage during flashing and upset; essential parts of drum welder; schematic diagrams of test circuit. Gives details of calculations.

22-507. **Current Developments in Equipment and Design.** Charles Owen Brown. *Industrial and Engineering Chemistry (Industrial Edition),* v. 38, Oct. 12, '46, p. 73-74.

Application of welding to repair of cracks and broken parts, and to the replacement of metal worn or corroded away over relatively large areas. Also reproduces Air Reduction Sales Co.'s chart of welding symbols.

22-508. **Flexible Low-Cost Welding Unit.** F. J. Jacobi. *Production Engineering & Management,* v. 18, Oct. '46, p. 55.

Both circumferential and longitudinal welds can be made with an assembly which incorporates an adjustable mechanism for close positioning the head.

22-509. **The Welding of Nonferrous Metals. Part VIII. The Welding of Copper and Its Alloys. (Continued.)** E. G. West. *Sheet Metal Industries,* v. 23, Oct. '46, p. 1979-1984, 1990.

Weldability of copper; physical characteristics; gas porosity; reactions with oxygen; changes during welding; gassing; tendency to crack; effect of welding on properties.

22-510. **The Principles and Some Applications of Atomic-Hydrogen Welding.** I. H. Hogg. *Sheet Metal Industries,* v. 23, Oct. '46, p. 1985-1989.

Equipment; hydrogen supply; automatic welding appli-

cations: Bren gun magazine; transformer radiators; examples of hand welding; manufacture of blanking tools; repair of blanking tools.

22-511. **Miniature Electric Arc Welding Appliances.** *Sheet Metal Industries,* v. 23, Oct. '46, p. 1992.

Apparatus for small, medium and high output. Smallest type is intended for handling fine and ultra-fine gage wires —0.02 to 0.5 mm. diameter. (Translated from *Luftwissen,* v. 10.)

22-512. **Spot Welding Technique for Primary Structures. Part I.** Frederick S. Dever. *Aviation,* v. 45, Oct. '46, p. 66-68.

Analyzes pertinent structural design considerations and details basic preparatory steps.

22-513. **Experiments in Brazing Thin Aluminum.** L. P. Saunders and P. S. Rogers. *Western Metals,* v. 4, Oct. '46, p. 28-30.

Summary of experimental work in brazing development using aluminum brazing sheet which consisted of a core of manganese-aluminum alloy coated on one or both sides with a lower melting point brazing alloy.

22-514. **Flame Deseaming.** *Iron and Steel,* v. 19, Oct. '46, p. 571-572.

Continuous oxy-acetylene process at work. Description limited to the "de-surfacer".

22-515. **Quantity Production of Railroad Passenger Cars by Resistance Welding.** A. M. Unger. *Welding Journal,* v. 25, Oct. '46, p. 911-914.

Techniques used by Pullman-Standard Car Manufacturing Co.

22-516. **How to Select Wear Resisting Alloys for Welding.** Joseph A. Cunningham. *Welding Journal,* v. 25, Oct. '46, p. 915-920.

Ten factors which should be considered when choosing hard surfacing electrodes or rods. Information on how to select hard facings is arranged in a convenient table, which gives properties, uses, prices, appearance, and welding characteristics of nine compositions.

22-517. **Welded Pier Leg, Shear Leg and Trolley of a 15-Ton Ore Bridge.** George F. Wolfe. *Welding Journal,* v. 25, Oct. '46, p. 921-927.

In the construction of a 15-ton ore bridge for installation at the Bethlehem, Pa., plant of the Bethlehem Steel Co., electric arc welding was used for the first time on several major components. Except for the main truss span and a few steel castings used in conjunction with weldments, all parts of the bridge are welded. Fabrication and erection techniques are described and illustrated.

22-518. **Some Problems of Welding Design and Fabrication of Steel Floating Drydocks.** A. Amirikian. *Welding Journal,* v. 25, Oct. '46, p. 929-935.

Techniques used by the Navy's Bureau of Yards and Docks are illustrated by photographs and detail drawings. Welding sequence and erection procedure is outlined.

22-519. **Welding of Electric Apparatus.** E. F. Potter. *Welding Journal,* v. 25, Oct. '46, p. 942-945.

Applications of metal-arc welding, gas welding and resistance welding; engineering, design, and fabrication.

22-520. **Some Recent Canadian Contributions to Oxygen Cutting.** R. A. Dunn. *Welding Journal,* v. 25, Oct. '46, p. 946-952.

These include low-pressure cutting techniques for cutting alloy steel billets; complete cutting of shell blanks from steel billets at room temperature; and use of process for production of machine guns and automatic pistols. Techniques described and illustrated.

22-521. **Tool and Die Welding.** A. R. Butler and F. E. Kessler. *Welding Journal,* v. 25, Oct. '46, p. 953-961.

Discusses separately the four phases: repairing, composite fabrication, design correction, and error rectification. Details of products and procedure are given for the metallic-arc and oxy-acetylene welding methods, including heat treating techniques.

22-522. **The E601X Electrode Group.** Orville T. Barnett. *Welding Journal,* v. 25, Oct. '46, p. 962-968.

Details of the properties and applications of the five types of electrodes in the group.

22-523. **Pressure Gas Welding of Alloy Steel Tubing.** J. L. Zambrow and R. D. Williams. *Welding Journal,* v. 25, Oct. '46, p. 585s-596s.

An investigation of the factors which control the quality of oxy-acetylene pressure welded joints in thick-walled, high-strength, alloy steel tubing. Welding was done by the closed-joint method, in which the welding faces are in contact under pressure throughout the welding cycle. First phase of investigation involved design and construction of the welding machine and auxiliary equipment. Then various operation sequences, joint types, and protective coatings and atmospheres were investigated. Maximum consistent strength level established was of the order of 150,000 psi. Results indicate that strong joints equal or superior to those made by other common welding processes can be obtained with advantages of relatively high production speeds and relatively low initial equipment cost. 25 ref.

22-524. **Investigation of the Weldability of Copper-Bearing Steels.** N. H. Keyser and C. H. Lorig. *Welding Journal,* v. 25, Oct. '46, p. 597s-611s.

Study of the metal-arc weldability of a number of low-alloy wrought and cast steels was made to determine the feasibility of using copper in place of carbon to confer the required strength to steels which would, at the same time, have superior weldability. A series of tests on arc-welded plates was used as a measure of weldability. It was found that copper-bearing steels generally have considerably better notched-bar toughness in all zones of the weld than carbon steels.

22-525. **A Summary of the Spot Welding of High-Tensile Carbon and Low-Alloy Steels.** W. D. Doty and W. J. Childs. *Welding Journal,* v. 25, Oct. '46, p. 624s-630s.

Optimum welding conditions for the spot welding and tempering in the welding machine of eight different steels in a variety of thicknesses. From these data general relationships have been established which are of important application to the selection of welding conditions for making tempered spot welds in any high-tensile carbon or low-alloy steels within the thickness range from 0.018 to 0.125 in.

22-526. **Welding Research as Applied in the South.** W. W. Austin, Jr., and E. N. Kemler. *Welding Journal,* v. 25, Oct. '46, p. 630s-633s.

Present status of recent developments and current problems in the utilization of welding as a fabrication method in the South.

22-527. **An Investigation of the Effect of Welding on the Transition Temperature of Navy High-Tensile, Low-Alloy Steels.** George G. Luther, Carl E. Hartbower, Richard E. Metius, and Frank H. Laxar. *Welding Journal,* v. 25, Oct. '46, p. 634s-645s.

A number of ship service failures occurring in recent years brought up the question of effect of welding on the transition temperature of a plate material. It was the object of this investigation to find a weldability test specimen which would determine the transition temperature of a steel and at the same time reproduce the fracture characteristics observed in brittle ship failures. It was found that welding frequently raises the transition temperature of a steel. Two weldability test specimens, the Charpy V-notched bar and a hitherto unreported specimen—the high-constraint nick bend, were found suitable for comparing the performance of welded and unwelded plate at various temperatures.

22-528. **Welding of High-Strength Constructional Steels With Ferritic Electrodes.** S. A. Herres and P. E. Woodward. *Welding Journal,* v. 25, Oct. '46, p. 646s-657s.

Properties of butt welds made with four brands of ferritic electrodes in quenched and tempered alloy steel plates of ½ in. thickness were determined. Included are discussions of selection of suitable base metals for 90,000, 120,000, and 150,000-psi. yield strengths, tests of weld metal properties of undiluted deposits made with commercial alloy ferritic electrodes, use of "Double T" fillet weld specimens to determine susceptibility of welded joints to cracking during welding, and tests of properties of welded joints.

22-529. **The Flash Welding of Hard Drawn High-Carbon Steel Wire.** R. W. Bennett and R. D. Williams. *Welding Journal,* v. 25, Oct. '46, p. 658s-668s.

Development of a process for making welded joints in cold drawn, high-carbon steel wire of 220,000 psi. ultimate tensile strength which would have the same strength, ductility and toughness characteristics as the wire. After early tests had shown conventional methods to be unsatisfactory, an automatic heat treatment of the welded joint was developed which transformed the austenite in the weld zone directly into a soft, relatively ductile structure consisting largely of pearlite.

22-530. **Welding of Hardenable Steels With High-Alloy (Austenitic) Electrodes.** S. A. Herres and A. M. Turkalo. *Welding Journal,* v. 25, Oct. '46, p. 669s-686s; appendix p. 686s-696s.

Reviews literature on the process and gives data as to the tensile and impact properties of selected base metals and of austenitic weld deposits and the mechanical properties of weld joints made in various constructional steels. 38 ref.

22-531. **Redistribution of Residual Welding Stresses by Tensile Loading Along a Unionmelt Weld Joining Two 3-Ft.x 12-Ft.x1-In. Plates.** J. L. Meriam, E. Paul DeGarmo and Finn Jonassen. *Welding Journal,* v. 25, Oct. '46, p. 697s-699s.

Two tests were made wherein a Unionmelt weld connecting two plates was pulled in tension along the weld and then the external load removed. Residual stress pattern existing after removal of the load was then measured and adjustment of residual stresses determined.

22-532. **Selecting Spot Welding Schedules for Low-Carbon Steel.** Julius Heuschkel. *Welding Journal,* v. 25, Oct. '46, p. 700s-728s.

Problems involved in the production of high-strength spot welded joints in low-carbon steels up to ½ in. in thickness were experimentally investigated. A series of interrelationships between the different variables was discovered to exist, most of which have been reduced to mathematical terms. Results are summarized in the form of a table giving recommended single impulse data for use on plates up to ½ in. in thickness. 31 ref.

22-533. **Practical Importance of Hydrogen in Metal-Arc Welding of Steel.** S. A. Herres. *American Society for Metals Preprint,* no. 30, 1946, 29 p.

Hydrogen derived principally from ingredients in the electrode coating is absorbed by molten weld metal. Porosity, caused by the trapping of gas bubbled in the solidified weld metal, is ordinarily controlled by the relative contents of hydrogen, oxygen, carbon, and silicon in the weld metal. Effects of water vapor in controlling porosity and of hydrogen-sulphur or hydrogen-selenium reactions in producing porosity are illustrated. Hydrogen retained in solution in solid metal may cause localized or general embrittlement. Hydrogen diffusing into the weld heat-affected zone of alloy steels may cause severe embrittlement and cracking in this zone. Shows that the degree of hydrogen embrittlement is dependent upon the microstructure of the steel and the rate and temperature of straining.

22-534. **Inert-Arc Welding.** R. F. Wyer. *Iron Age,* v. 158, Oct. 31, '46, p. 57-58.

Process, recently developed by General Electric, makes use of a tungsten electrode and a shielding stream of helium or argon gas around the arc. Technique of applying the process to aluminum, magnesium, and stainless steel is described.

22-535. **Repair Maintenance Fabrication in the Plant Weldery.** *Industry and Welding,* v. 21, Oct. '46, p. 40-41, 61-64.

Uses of welding in large Hershey candy factory.

22-536. **Common Sense.** W. J. Conley. *Industry and Welding,* v. 21, Oct. '46, p. 42-44, 52.

Problems of heat and stress in welding.

22-537. **Resistance Welding of Stainless Steels.** J. J. Riley. *American Machinist,* v. 90, Nov. 7, '46, p. 112-115.

Spot and projection welding.

22-538. **Welding Alloy Steel Piping.** *Heating, Piping & Air Conditioning,* v. 18, Oct. '46, p. 67-70.

Techniques for joining 0.5 to 10% chromium-molybdenum alloys.

22-539. **Machine Tool Builder Fabricates Earth Mover.** *Iron Age,* v. 158, Nov. 7, '46, p. 53.

Boom, boom cradle, engine and pumps, operator's cab, and the hydraulic cylinders which control the boom are mounted on the rotating platform, which is a welded steel bed of structural members. The wings are welded on the platform by means of a special jig, then the assembly is turned over and the boom supports are welded on. Entire section is then scaled and cleaned. All subassemblies are prime coated before welding into main assemblies, after which they are painted.

22-540. **Automotive Repair Is Big Business.** *Linde Tips* (formerly *Oxy-Acetylene Tips),* v. 25, Oct. '46, p. 105-114.

Potential market survey and review of typical oxy-acetylene applications. Includes check list of oxy-acetylene repair methods.

22-541. **Welded Heavy Armored Fighting Vehicles. (Concluded.)** R. J. Fowler and L. E. Denaro. *Transactions of the Institute of Welding,* v. 9, Aug. '46, p. 115-127.

Electrode testing; ferritic welding; transverse cracking; armor steels with 0.30% carbon; low-allow high-tensile steel; stud welding; gas cutting and repair of armor castings. Use of welded armor in production of tanks, the factors which must be considered in determining the types of welded joints suitable for the armor and the practical welding methods used. Some mention is made of jigging and manipulation for welding which may be of value for assemblies other than welded armor.

22-542. **Arc Welding and Cutting Under Water.** E. Mills. *Transactions of the Institute of Welding,* v. 9, Aug. '46, p. 128-130.

Practical experience as well as experimental data. Underwater welding and cutting are as fundamentally simple as surface operations. The successful performance of underwater operations depends on obtaining a gaseous shield to protect the preheating medium, and more on the physical abilities of the operator than the actual use of the equipment. (To be continued.)

22-543. **Electro-Physics of the Welding Arc.** L. H. Orton. *Transactions of the Institute of Welding,* v. 9, Aug. '46, p. 131-133.

Research program; experimental technique; nature of the problems; implications of temperature; use of high-frequency spark discharge; lack of general theory.

22-544. **Cracking of Welded Gas Mains.** L. Reeve. *Transactions of the Institute of Welding,* v. 9, Aug. '46, p. 133.

Experiments to determine the causes of cracking. A minimum degree of stress must be present to produce failure which varies with the type of steel used; in the presence of severe plastic strain failure will occur within ten days with all mild and low-alloy steels tested; failures can be produced in suitably welded test pieces, and can be prevented by stress relief of such specimens.

22-545. **Production With Precision Flame Cutting.** Fred M. Burt. *Welding Engineer,* v. 31, Nov. '46, p. 43-47.

Describes how West Coast job shop uses the cutting torch for jobs that others figured could be done only in a machine shop to produce tolerances to the thousandth of an inch.

22-546. **Brazing an 1174-Lb. Casting.** D. R. Peterson. *Welding Engineer,* v. 31, Nov. '46, p. 52-53.

Method of brazing broken caterpillar drive gear.

22-547. **Welding Methods for Alloy Steel Piping. Part 3.** Eric R. Seabloom. *Welding Engineer,* v. 31, Nov. '46, p. 54-58.

How chromium-nickel or stainless steels should be handled.

22-548. **Automatic Stud Welding.** *Steel,* v. 119, Nov. 11, '46, p. 158, 160, 163, 234.

How various types of steel studs used in industrial applications are fused to metal surfaces by means of portable or stationary equipment designed for single operations or for mass production of parts.

22-549. **Spot Welding of Titanium.** R. S. Dean, J. R. Long, E. T. Hayes, and D. C. Root. *Metals Technology,* v. 13, Oct. '46, T. P. 2102, 8 p.

Effects of varying welding current, welding time, and tip pressure on single spot welds made on several different thicknesses of titanium sheet.

22-550. **Weldable High-Strength Steel Castings.** Welton J. Crooks. *Metal Progress,* v. 50, Nov. '46, p. 906-914.

Investigation of cracking which occurs when castings of high carbon and manganese content are welded without preheating as in gun carriage structures. Weldability tests on commercial steels; heat treatment for stress relief.

22-551. **Cutting Stainless Steel With the Electric Arc.** H. E. Linsley. *Iron Age,* v. 158, Nov. 14, '46, p. 96-98.

Important developments in the cutting of stainless steel, copper, monel and other ferrous and nonferrous alloys. Called Oxyarc cutting, process involves the use of a tubular mild steel rod through which a stream of oxygen is supplied to the arc. Operation is extremely fast, and parent metal is not contaminated.

22-552. **Pressure Vessel Production.** *Welding,* v. 14, Oct. '46, p. 446-459.

Recently built welding shop designed especially for the manufacture of large Class 1 pressure vessels, completed with the latest types of equipment.

22-553. **Oxygen Cutting. Part 4. Manual and Machine Methods.** *Welding,* v. 14, Oct. '46, p. 469-473.

Latest type of equipment and technique; appropriate operating data.

22-554. **Progress in Research.** *Welding,* v. 14, Oct. '46, p. 479-480.

Survey of recent investigations of atmospheres in welding.

22-555. **Railroads Give Welding Right of Way.** L. E. Grant. *Industry and Welding,* v. 21, Nov. '46, p. 34-36, 66, 69-70, 72.

Current practices and new developments in railroad welding.

22-556. **Inert Arc Welding.** D. W. Puffer. *Steel,* v. 119, Nov. 18, '46, p. 80-82, 116, 119.

Advantages include elimination of flux, stability of chemical composition of molten metal and ability to weld magnesium and its alloys in virtually all thicknesses.

22-557. **Induction Soldering.** *Steel,* v. 119, Nov. 18, '46, p. 96.

Increases radiator assembly production 280% and saves $7000 in solder costs annually with a prefabricated solder ring. The ring contains the exact amount of solder required in each operation.

22-558. **Induction Heating Cuts Operation Time.** *Production Engineering & Management,* v. 18, Nov. '46, p. 75.

Production rate was increased 180% on radiator soldering job by the use of induction heating setup.

22-559. **Welding, Flame Cutting for Efficient Maintenance and Low Cost.** A. D. Stout, Jr. *Coal Age,* v. 51, Nov. '46, p. 100-104.

Applications in the maintenance of transportation equipment, including track, cars and locomotives.

22-560. **Spot Welding Technique for Primary Structures. Part II.** Frederick S. Dever. *Aviation,* v. 45, Nov. '46, p. 64-65.

Important operational factors pertinent to equipment; Army and Navy weld specifications; inspection procedures.

22-561. **Resistance Welding of Stainless Steels—2.** J. J. Riley. *American Machinist,* v. 90, Nov. 21, '46, p. 108-112.

Seam welding variables.

22-562. **The Welding of Light Alloys.** *Metallurgia,* v. 34, Oct. '46, p. 321-324.

Welding of aluminum-magnesium alloys; aluminum alloys for gas welding with special reference to aluminum-silicon-copper alloys; pressure welding of light alloys without fusion; examination of light alloy flash welds made by a Swedish company; industrial practice for spot welding; present trends in American machine design; technique for the gas welding of magnesium alloys; the tensile strength of gas welds in manganese alloy to specification D.T.D. 118.

22-563. **Layouts for Machine Gas Cutting Made With Wrapping Paper.** Elmer Kappel. *Materials & Methods,* v. 24, Nov. '46, p. 1229.

Substitution of ordinary wrapping paper for a plate of sheet iron.

22-564. **Industry Embraces Weldments.** Edwin Laird Cady. *Scientific American,* v. 175, Dec. '46, p. 245-248.

Full advantage can be taken of all-metal fabrication

methods and of desirable characteristics of metals themselves. Weldments reduce the need for complicated casting and intricate machining.

22-565. **Het Solderen Van Aluminiumhoudende Zinklegeringen. (How to Solder Aluminum-Containing Zinc Alloys.)** F. K. T. Beukema Toe Water and H. C. J. De Decker. *Metalen,* v. 1, Oct. 15, '46, p. 23-27.

Results of investigation performed in the Central Material Research Institute of Delft (Holland) showed that zinc alloys containing aluminum up to 0.7% may be successfully soldered either by special soft cadmium-containing solder using an active zinc-ammonium chloride flux, or by common soft tin-lead solder using a nominal flux after the alloy has been coated with zinc. Zinc alloys containing up to 4% Al may be soldered with any soft solder using a common flux, but only after the alloy has been coated with a galvanic zinc layer.

22-566. **Resistance Welding With Storage-Battery Power.** John D. Gordon. *Welding Journal,* v. 25, Nov. '46, p. 1049-1054.

Construction and operation of this type of welding equipment, which permits resistance welding of aluminum and its alloys at lower cost and in areas removed from high-capacity power lines.

22-567. **Additional Timing Period of New Motor-Driven Control Increases Gun Welder Speed.** H. I. Stanback. *Welding Journal,* v. 25, Nov. '46, p. 1055-1060.

Requirements and problems in resistance spot welding at high production rates. Development and operation of a new high-speed sequence weld timer using cam-operated contacts driven by a synchronous motor.

22-568. **Design and Production Control of Silver Alloy Brazed Joints in Aircraft Structures.** H. A. Smith and P. A. Koerner. *Welding Journal,* v. 25, Nov. '46, p. 1061-1067.

Preliminary survey of design and fabrication methods. Constant and variable factors in design of such joints; rules for preparation and assembly, heating, cooling, and defluxing; rules for certification of operators.

22-569. **Oxy-Acetylene Pressure Welding of Some Low-Alloy Steels and Nonferrous Alloys.** Kenneth H. Koopman. *Welding Journal,* v. 25, Nov. '46, p. 1069-1076.

Data collected in the course of development of procedures for pressure welding various steels and nonferrous alloys. Description of tests of pressure welds made in the following steels: S.A.E. X4130; 0.28% C, 1.60% Mn, 0.43% Mo steel; N.E.8740; N.E.8630; N.E.8620; 5% Cr, 0.50% Mo steel; carbon-silicon spring steel. Tests of pressure welds in the following nonferrous alloys: nichrome (80% Ni 20% Cr); monel; everdur; aluminum-iron bronzes; tobin bronze. 11 ref.

22-570. **Control of Welding Stresses by Welding Sequence.** Paul Ffield. *Welding Journal,* v. 25, Nov. '46, p. 1109-1122.

Details of Bethlehem Steel's research on determination of the characteristic pattern of stresses in welded ships and on the possibilities of making these stresses contribute to rather than detract from the strength of the struc-

ture. Stresses determined, using a model, agreed quite well in most cases with those determined on a Destroyer Escort. Recommendations are given for welding sequence to develop desired stress patterns.

22-571. **A Method for Determining the Applicable Welding Procedure for Steels.** Bela Ronay. *Welding Journal,* v. 25, Nov. '46, p. 736s-747s.

New method utilizes high-frequency heating to confine a large energy input to a relatively small volume, thereby simulating the heat concentration obtained in arc welding, and avoiding various drawbacks of other methods. Extensive details of the equipment, method, and results of application to six high-tensile steels are given. Also describes notch-bend test using plungers of graduated radii to evaluate the notch sensitivity of each heat or shipment of steel.

22-572. **Arc Atmospheres and Underbead Cracking.** Manley W. Mallett and Perry J. Rieppel. *Welding Journal,* v. 25, Nov. '46, p. 748s-759s.

Experimental methods used and results obtained in an investigation of arc-atmosphere compositions and their relation to underbead cracking of hardenable alloy steels; synthetic arc atmospheres and underbead cracking; changes in composition of synthetic arc atmospheres on passing through a metal arc; hydrogen and underbead cracking. An atmosphere of equal parts CO and CO_2 gave good arc characteristics, no underbead cracking or porosity and, in general, a better welding arc than any other combination of gases used.

22-573. **The Control of Weld Hot Cracking in Nickel-Chromium-Iron Alloys.** T. E. Kihlgren and C. E. Lacy. *Welding Journal,* v. 24, Nov. '46, p. 769s-775s.

Study of weld hot cracking encountered in the manual arc welding of nickel-chromium-iron alloys containing 25 to 80% of nickel and 15 to 20% of chromium indicates that silicon causes weld hot cracking in these alloys and that introduction of columbium into the fusion counteracts the effect of silicon. When Cb to Si ratio in the weld metal exceeds a minimum value, which varies from alloy to alloy, uncracked welds can be consistently obtained.

22-574. **The Weldability of Ship Steels.** Ernest F. Nippes and Warren F. Savage. *Welding Journal,* v. 25, Nov. '46, p. 776s-787s.

A study of the effects of travel speed, preheat temperature and arc power level on the notch toughness of weld metal and heat-affected zone.

22-575. **Some Observations on the Weldability of High-Strength Wrought Aluminum Alloys.** William R. Apblett, Jr. *Welding Journal,* v. 25, Nov. '46, p. 802s-808s.

Tensile and slow bend tests indicate strength of 61S-T, 24S-T and 75S-T alloys is not utilized to the full extent because of present-day electrodes and the deleterious effect of welding on wrought aluminum alloys. Recommends future work on development of electrodes which will produce better mechanical properties in the deposited weld metal and development of more weldable aluminum alloys.

22-576. **Automatic Welder Embodies New Principle.** *Iron Age,* v. 158, Nov. 28, '46, p. 67.

Development of automatic multispot resistance welding machines. In addition to high speed of operation, an outstanding advantage is that the various welding guns can weld different thicknesses of metal requiring variable welding times, heats and speeds.

22-577. **The Theory of Moving Sources of Heat and Its Application to Metal Treatments.** D. Rosenthal. *Transactions of the American Society of Mechanical Engineers,* v. 68, Nov. '46, p. 849-865; discussion, p. 865-866.

Outlines the fundamentals of this theory and derives appropriate solutions for linear, two and three-dimensional flow of heat in solids of infinite size or bounded by planes. Point, linear, and plane sources of heat are examined. Solutions obtained are applied to welding problems. These solutions are in good agreement with the experimental results and permit close analysis of the factors governing heat flow in welding. Formula for predicting time and rate of cooling with fairly good accuracy for a wide variety of thicknesses of steel is derived. Shows how this theory could be applied to other problems in metal treatment. 20 ref.

22-578. **Characteristics of Welding Arcs on Aluminum in Atmospheres of Helium and Argon.** F. A. Wassell. *Aluminium and the Non-Ferrous Review,* v. 2, July-Sept. '46, p. 66-70.

An investigation based on the principle of gas-shielded arc welding, utilizing inert gases such as helium and argon for the purpose of developing a process which would eliminate the use of flux in the welding of aluminum.

22-579. **Reducing Welding Cost With Jigs.** *Sheet Metal Worker,* v. 37, Nov. '46, p. 33-35.

Assembly and holding fixtures for faster, better work, utilization of less skilled mechanics, and time saving.

22-580. **Oxygen-Arc Cutting.** *Steel,* v. 119, Dec. 2, '46, p. 116, 118.

In combining a stream of oxygen with the arc by means of a tubular electrode, a cutting temperature is obtained that is 3000° hotter than that usually realized with common cutting methods. Process has been used to cut a variety of metals occurring in the form of sheets, plates and castings, as well as to cut metals in any shape and under various conditions.

22-581. **Influence of Magnetic Materials on the Welding Characteristics of Resistance Welding Machines.** J. J. Riley and C. E. Smith. *Electrical Engineering Transactions,* v. 65, Nov. '46, p. 852-860.

Introduction of magnetic material into the throat of such equipment causes a reduction of the welding current. Effects on welding current produced by changing sheet thickness and width, length inserted, position, and current used for welding. Results are charted and tabulated, and application to practical problems illustrated by sample calculations.

22-582. **The Welding of Nonferrous Metals. (Continued.) Part VIII.** E. G. West. *Sheet Metal Industries,* v. 23, Nov. '46, p. 2183-2188.

Oxy-acetylene welding of copper and its alloys. (To be continued:)

22-583. **Resistance Welding of Stainless Steels. Part 3.** J. J. Riley. *American Machinist,* v. 90, Dec. 5, '46, p. 134-138.

Advantages of flash welding are high speed, little or no preparation of parts for welding, close tolerances of finish product, and phyiscal properties more similar to the parent metal than welds made by any other process. Applications are primarily restricted to butt joints and particularly those in which the weld components are of equal size as well as symmetrical in shape and cross-sectional area.

22-584. **Welding in the Home.** C. F. Block. *Welding Engineer,* v. 31, Dec. '46, p. 39-42.

New home construction offers stel cabinets for bedroom, basement and kitchen, enameled steel shower stalls, stainless steel basins and toilets, prefabricated steel staircases, steel tiles and panels, steel structural members.

22-585. **Furnace-Brazed Steel Parts.** J. E. Jevons. *Welding Engineer,* v. 31, Dec. '46, p. 47-49.

First successful use; continuous furnaces; types of atmospheres; times and temperatures; causes of failure; strength of joints; suggested applications; batch brazing.

22-586. **Effects of Current Shunting on Spot Welds.** Julius Heuschkel. *Welding Engineer,* v. 31, Dec. '46, p. 55-57.

Test results re-emphasize the possible significance of permitting the production use of uncompensated current shunting. Data were obtained from welds and joints in ¼-in. plain carbon steel. The seven specimens shown were all made within the same time interval with the same force on the same machine, using the different heat control settings that are listed. All welds were made with a single impulse of 60 cycles (1 sec.) duration. All of the specimens were 5 in. wide.

22-587. **Welding German U-Boats.** *Welding Engineer,* v. 31, Dec. '46, p. 61-62.

Methods and welding sequences used at a German shipyard to build the late type XXI U-boats. Prefabricated sections were employed, and eight welders worked at once on a circumferential seam.

22-588. **Soldering and Brazing of Stainless Steel Piping.** Eric R. Seabloom. *Welding Engineer,* v. 31, Dec. '46, p. 63-66.

What solders, brazing alloys and fluxes to use to join stainless tubing and fittings. Techniques of making capillary soldered and brazed joints on stainless alloys.

22-589. **Welding.** *Russian Technical Research News,* v. 1, no. 4, '46, p. 1.

Russians challenge J. M. Keir's (Linde Air Products) theory that finer-grained flux gives a wider bead. Experiments gave opposite results. Also found that arc-poten-

tials rise with grain size and that amount of flux consumed per unit of time increases with grain size and with speed of welding. Describes small portable electric welder. (Abstracted from *Autogennoye Delo,* no. 1, 1946.)

22-590. **What Changes to Improve Welding Codes and Specification?** *Product Engineering,* v. 17, Dec. '46, p. 81-84.

Criticisms and suggestions are presented with the hope that they may stimulate interest and action toward the preparation of better specifications.

22-591. **Contact Arc Welding.** P. C. Van Der Willigen. *Iron Age,* v. 158, Dec. 12, '46, p. 58-62.

New welding technique employs special electrodes in which more than 50% of the weld metal is contained in the coating. Process may be used by entirely unskilled workers since the end of the electrode is held in contact with the work at all times and merely drawn along the surface. Contrasts current European welding practice with American methods.

22-592. **Wood-To-Metal Adhesives.** Thomas D. Perry. *Mechanical Engineering,* v. 68, Dec. '46, p. 1035-1040.

Some practical applications; fundamentals of adhesion; origin of metal-to-wood gluing; methods of metal-to-wood gluing; metal-to-wood applications; nonplywood applications.

22-593. **Welding Fixtures for Mass Production.** A. E. Rylander. *Tool Engineer,* v. 17, Dec. '46. p. 21-27.

Simple fixtures and straightline flow of materials result in ease of operation and a very high production potential.

22-594. **Fixtures Make Welders Flexible. Part I.** Ed Reilly. *American Machinist,* v. 90, Dec. 19, '46, p. 104-107.

Examples of current setups over a range of commercial items.

22-595. **Powder Metal Welding Rods.** F. C. Kelley and F. E. Fisher. *Iron Age,* v. 158, Dec. 19, '46, p. 68-72.

Method of producing 18-8 welding rods by extruding a powdered metal mixture, which results in a rod having very satisfactory welding characteristics. The metal is deposited in the form of a fine spray. Technique described for the first time.

22-596. **Welding With Complex Aluminum Bronze Electrodes.** F. C. Evans and G. Haim. *Welding,* v. 14, Nov. '46, p. 501-510.

Development of complex aluminum-bronze electrodes and properties of the weld deposits. Welding technique and practical applications.

22-597. **Oxygen Cutting. Part V. Manual and Machine Methods.** E. Seymour Semper. *Welding,* v. 14, Nov. '46, p. 520-526.

Latest type of equipment and technique, and appropriate operating data.

SECTION XXIII

INDUSTRIAL USES AND APPLICATIONS

23-1. **100 Years of Progress in Making Fasteners.** L. E. Browne. *Steel,* v. 117, Dec. 24, '45, pp. 82-85, 112.

Continuous boltmakers and other automatic equipment represent great advance in production methods.

23-2. **A Report on German Manufacture of Bolts, Screws, Nuts and Rivets.** Roy Harmon Smith and Charles F. Newpher. *Screw Machine Engineering,* v. 7, Dec. '45, pp. 58-61.

Raw materials, chemical content, operation and methods determined, together with number of employees and tons of product per month or per year. Observations concerning threading of bolts and screws.

23-3. **Step by Step to a Better Product.** R. R. Todd. *Die Casting,* v. 3, Dec. '45, pp. 26-28, 49-51, 53.

Shows that die castings are key to mass production methods for assembling 1100 complete washing machines daily.

23-4. **A Challenge Met.** L. F. Mitchell. *Die Casting,* v. 3, Dec. '45, pp. 30-32, 53-54.

Use of die castings in Addressograph machine; costs; stress; dimensional accuracy; abrasive resistance; dynamic properties; appearance.

23-5. **Throwing New Light on a Subject.** *Die Casting,* v. 3, Dec. '45, pp. 35-36, 56.

Die castings for modern lighting fixtures provide designers with unlimited possibilities in beauty and styling to harmonize with any type of interior decoration.

23-6. **Die Cast? Built Up?** *Die Casting,* v. 3, Dec. '45, pp. 38-40, 59-60.

Failure to recognize the ability of die castings to supplant built-up assemblies in many products may lead to higher production costs than are necessary.

23-7. **Postwar Packaging for Chemicals.** *Chemical Industries,* v. 57, Nov. '45, pp. 841-845.

Steel drums; multiwall bags; cloth and papercloth bags; fiber drums; fiber boxes; metal foil; wooden barrels; alloys; tank cars; plastics; palletization; general.

23-8. **Special-Purpose Bronzes.** J. A. Oates. *Aircraft Production,* v. 7, Dec. '45, pp. 595-602.

Laboratory control; sand foundry equipment; Durville billet-casting process; rolling and forging.

23-9. **Producing License Plates at Norris.** Fred M. Burt. *Products Finishing,* v. 10, Dec. '45, pp. 40-42, 44.

Procedures followed at Norris Stamping and Manufacturing Co., in production of 3,500,000 single 1945 California automobile license plates on continuous and largely automatic basis.

23-10. **Making Wedge Wire Screens of Stainless Steel.** *American Machinist,* v. 89, Dec. 20, '45, pp. 201-203.

Fabrication of special screens for industrial purposes requires stainless that is uniform and will stand severe deformation—both hot and cold.

23-11. **Fabricating High Strength Aluminum Alloys.** Roy A. Miller and Max E. Tatman. *Iron Age,* v. 156, Dec. 27, '45, pp. 40-44.

Precipitation hardening aluminum alloys which are replacing unaged 24S-T in new aircraft designs can be fabricated with minimum of shop difficulties. Their mechanical properties, heat treating operations, effects of cold work, as well as problems connected with forming, attachment, machinability and finishing included. (Paper presented before SAE, Los Angeles.)

23-12. **The Production of Precision Spiral Bevel Instrument Gears.** J. R. Westwood. *Machinery (London),* v. 67, Dec. 13, '45, pp. 665-668.

Difficulties encountered in the production of precision gears can be avoided by greater care in manufacture of gear blanks.

23-13. **Heavy Wall Pipe.** E. C. Wright. *Steel,* v. 117, Dec. 31, '45, pp. 70, 72.

Problems encountered in manufacturing heavy wall pipe for high pressure steam service may be solved by standardizing wall thicknesses, rolling only one length in any given diameter and wall thickness, and by buying billets of only one diameter and weight for rolling each pipe size.

23-14. **Stainless Steels.** Edwin Laird Cady. *Materials & Methods,* v. 22, Dec. '45, pp. 1761-1776.

A guide to choosing and processing the most frequently used grades of wrought stainless steels, based on the experiences of the processing experts of stainless steel producers. Discusses those grades most readily accessible to the small and moderate-size users.

23-15. **Light Metals in the Food and Allied Industries. Part I.** *Light Metals,* v. 8, Dec. '45, pp. 622-625.

Examines briefly general characteristics of light alloys with emphasis on those properties which make these metals of interest to the food industry. Certain present, and a few potential, applications in specific fields.

23-16. **Aluminum and Magnesium in the Fairchild Packet.** Lee Worley. *Modern Metals,* v. 1, Dec. '45, pp. 12-15.

Itemizes some of more pertinent applications.

23-17. **The Aluminum Half Ponton.** J. P. Arens. *Modern Metals,* v. 1, Dec. '45, pp. 16-17.

Discusses fabricating, assembling and finishing.

23-18. **Gear Manufacture.** Carlton A. Sheffield. *Western Machinery & Steel World,* v. 36, Dec. '45, pp. 547-551.

Discusses equipment and procedures at Joshua Hendry Iron Works where gears ranging from 3 in. to 147 in. in diameter are produced.

23-19. **Wet-Pack Cans.** W. B. Adam and D. Dickinson. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 573-576.

Substitution of blackplate for tinplate for fruit and vegetable preservation.

23-20. **Zirconium in Industry.** M. Schofield. *Industrial Chemist,* v. 21, Dec. '45, pp. 641-643.

Extraction methods; properties; zirconium oxide; use as refractory.

23-21. **Cromol Crankshafts.** *Automobile Engineer,* v. 35, Dec. '45, pp. 537-541.

Factors involved in the use of high duty alloy iron castings; details given of the chemical composition and the mechanical properties of Cromol, the alloy cast iron specially developed by the Midland Motor Cylinder Co., Ltd., for crankshafts. Metal structure that is desirable also described. Some of the important design factors are discussed.

23-22. **A Metallurgical Study of German Aircraft Engine and Airframe Parts; Section 8—Gears; Section 9—Bearings.** *Metallurgia,* v. 33, Dec. '45, pp. 64-72.

Summarizes results of metallurgical examination of 21 gear wheels. Observations confined to purely metallurgical aspects of the steel as regards quality and structure. Results of examination of crankshaft main bearings and connecting rod bearings from the same general engine types which have been considered in the investigations already reported.

23-23. **Wear Resistant Steel Castings for the Mining Industry.** T. E. Norman. *Metallurgia,* v. 33, Dec. '45, pp. 83-84.

Better machinability and wear resistance, high yield strengths, ease of production, desirable magnetic properties and low first cost are a few of the advantages they possess. Brief summary is given here of certain types of these chromium-molybdenum low alloy steels which have been found particularly suited to the needs of the mining industry.

23-24. **Alloy Steels for Maintenance.** J. A. Rosa. *Metallurgia,* v. 33, Dec. '45, pp. 105-106.

To select a steel properly an analysis must be made of the job. Some of the factors which must be considered in making a selection are: Size of the section; strength requirement; wear characteristics at high or low hardness; notch sensitivity or fatigue endurance; response to the desired heat treatment; machinability; method of fabrication; resistance to corrosion; strength-weight ratio; and present and future availability. (Taken from *Iron & Steel Engineer.*)

23-25. **Die Castings in Electrical Control Apparatus.** Herbert Chase. *Electrical Manufacturing,* v. 37, Jan. '46, pp. 108-111, 202.

Elements which can be die cast may require less machining, assembly operations and finishing. Applications in relay, timer and switch parts, connectors and motor components are discussed.

23-26. **What Can Be Done With Magnesium Alloys.** N. H. Simpson, K. E. Dorcas and Paul R. Cutter. *Electrical Manufacturing,* v. 37, Jan. '46, pp. 131-133, 216, 218, 220, 222, 224, 226.

Review of some of the possible applications of these new alloys, prepared in the light of wartime experience, particularly with electrical equipment.

23-27. **16-25-6 Alloy for Gas Turbines, Part I.** Martin Fleischmann. *Iron Age,* v. 157, Jan. 17, '46, pp. 44-53.

New alloy developed for gas turbine and turbo-supercharger applications described. Alloy, 16-25-6, has high creep resistance at elevated temperatures, which has made it valuable in jet engine applications.

23-28. **Which Aluminum Alloy for Your Product? Part I.** James L. Erickson. *Die Casting,* v. 4, Jan. '46, pp. 36-38, 54.

Review of aluminum die casting alloys which has been compiled for the product designer in order to enable him to determine what alloy will best meet the service requirements for a particular application.

23-29. **Die Castings in the Business Machine Field.** *Die Casting,* v. 4, Jan. '46, pp. 40-42, 44-46.

Die castings make use of most favorable methods of production.

23-30. **Wrought Magnesium.** Irving T. Bennett. *Modern Metals,* v. 1, Jan. '46, pp. 6-11.

Describes alloy additions; available wrought alloys; methods of fabrication; design considerations; applications and magnesium's future potential.

23-31. **The Aluminum Bazooka.** *Modern Metals,* v. 1, Jan. '46, pp. 12-13.

Use of aluminum cut the weight to 10 lb. and the barrels were found to be more resistant to denting than the steel predecessor.

23-32. **Boron Carbide: A Challenge.** Fred P. Peters. *Scientific American,* v. 174, Jan. '46, pp. 8-10.

Some examples of its uses in blast nozzles, gage parts, mortar and pestle, cutting tools, blasting masks, and extrusion dies.

23-33. **Stainless Steels for Turbine Blading.** J. H. G. Monypenny. *Engineering,* v. 160, Nov. 30 and Dec. 7, '45, p. 458-460, 478-480.

Results of salt spray tests and physical properties of stainless materials for turbine blading. Effects produced by slight modification in composition of stainless materials. Properties of stainless steel for turbine blading at high steam temperatures. Methods of fabrication and fitting of blading, and possible effects produced.

23-34. **Light Alloy Bicycles in Switzerland.** *Light Metals,* v. 9, Jan. '46, p. 3-6.

Economic and design factors which have tended toward the growing use of aluminum in the Swiss cycle industry.

23-35. **Light Alloys in Rectifiers, Photocells and Condensers.** *Light Metals,* v. 9, Jan. '46, p. 9-21.

Manufacture is described, with particular reference to the properties, handling and processing of the aluminum foils employed.

23-36. **All Light-Metal Caravan.** *Light Metals,* v. 9, Jan. '46, p. 48-50.

Brief notes on the design, construction and performance.

23-37. **Aluminium and Magnesium in the Electrical Industries.** B. J. Brajnikoff. *Light Metals,* v. 9, Jan. '46, p. 51-56.

Detailed consideration of the changes involved in the substitution of anodized aluminum windings for copper windings in electrical machinery. 3 ref.

23-38. **Beryllium Copper—A New Alloy.** L.S. *Machinery (London),* v. 67, Dec. 20, '45, p. 699-702.

Natural source of beryllium; electrical importance of the alloy; heat treatment; mechanical treatment.

23-39. **Full Details of the Crosley-Taylor Engine.** *Automotive and Aviation Industries,* v. 94, Jan. 15, '46, p. 18-21.

Major features include composite cylinder block and heads made of copper-hydrogen brazed sheet steel parts, five main bearing crankshaft of cast type, overhead camshaft and valve mechanism.

23-40. **Features of the I-40 Gas Turbine.** *Aero Digest,* v. 52, Jan. '46, p. 61, 116.

High strength alloys used; machining kept to minimum; five major sub-assemblies; simple oiling system.

23-41. **New Empire.** *Steel,* v. 118, Jan. 21, '46, p. 87, 103.

Outstanding feature of engine is the construction of the cylinder block which is made up of light-walled alloy steel tubing for the cylinders and cam follower guides, and of sheet steel stamping for the cylinder heads, intake and exhaust ports, valve cases, and water jackets. Parts are held in place by shrink fits, spot weld or crimping operations and form a firm structure even before brazing. Assembly is copper brazed in a specially constructed furnace at 2060° F. in a neutral atmosphere, after copper in sheet, strip, wire, or paste form has been applied to the joints.

23-42. **The Production of Torsion Bar Springs.** *Machinery (London),* v. 67, Dec. 27, '45, p. 721-727.

Torsion bars are 73 in. long and in two diameters along the body, 1.900 in. and 1.690 in. These diameters must be held within plus 0.022 in., minus 0.003 in. At the ends, the diameter is increased to 2½ in. on both sizes. The weight of the finished larger size is 65 lb. Out of approximately 35,000 torsion bar springs, only one has failed during fatigue tests, in which loads from 30,000 to 140,000 psi. are applied for about 80,000 cycles.

23-43. **Aircraft Engines.** E. Wood. *Metal Industry,* v. 67, Dec. 28, '45, p. 435-439.

Application and possible development of non-ferrous metals. Cylinder heads, pistons, crankcases (with one notable exception in steel), cylinder-barrels for sleeve-valve engines, supercharger casings, covers, gear boxes, accessory casings, are all made very largely in wrought or cast aluminum alloys.

23-44. **Fabrication of Magnesium Alloys.** A. W. Winston. *Metal Industry,* v. 67, Dec. 28, '45, p. 442-444.

American practice in making magnesium alloys; casting, extrusion, plate and sheet rolling, forging, die casting, fabricating. Importance of properly designing structural parts of these alloys, in particular when applying the high strength extruded shapes and sheet.

23-45. **16-25-6 Alloy for Gas Turbines.** Martin Fleischmann. *Iron Age,* v. 157, Jan. 24, '46, p. 50-60.

Cold worked properties; comparison with other austenitic and pearlitic steels.

23-46. **Brazed Sheet-Metal Automobile Engine.** *Iron Age,* v. 157, Jan. 24, '46, p. 61-63.

In making the cylinder barrels, S.A.E. 4140 tubing is turned, bored, chamfered, and cut off on Cone automatics, the only machining operation performed on the part except for grinding after assembly. Cam follower guides are machined from 4140 steel tubing, and valve seats are machined from a special chromium-tungsten-vanadium alloy. All other parts of the block, about 120 individual pieces, are stamped from S.A.E. 1010 deep drawing steel.

23-47. **Car Bracing With Steel Bands.** T. Pat Callahan. *Chemical Industries,* v. 62, Dec. '45, p. 1062-1063.

Use of steel bands for bracing packaged chemicals has proved efficient and inexpensive.

23-48. **Steels and Irons.** Fred P. Peters. *Materials and Methods,* v. 23, Jan. '46, p. 86-89.

Trends in ferrous materials engineering; high temperature alloys; new special-purpose steels; boron in malleable and gray iron; the "H" steels; electrical alloys and tool steels.

23-49. **Non-Ferrous Metals and Alloys.** Fred P. Peters. *Materials and Methods,* v. 23, Jan. '46, p. 90-95.

Aluminum and its alloys; magnesium alloys; copper alloys; ultra-hard materials; lead, tin, zinc, and bismuth alloys; bearing metals.

23-50. **Aluminium and the Automobile Engineer.** E. G. West. *Institution of Automobile Engineers Journal,* v. 14, Jan. '46, p. 109-146.

Heat treatment; specifications; wrought materials; casting alloys; piston alloys; bearing alloys; physical properties; mechanical constants; mechanical properties; resistance to corrosion; working characteristics; surface finishing; applications. 15 ref.

23-51. **Beryllium-Copper as a Mold Material.** Lawrence F. Boland. *Modern Plastics,* v. 23, Feb. '46, p. 139-142.

Beryllium-copper molds, whether sand cast or cast under pressure with a master die, stand up well under corrosive

action of some plastics and are low in cost, an important factor in novelty parts.

23-52. **Steam Tables for Molding Dies.** John H. Burkham. *Modern Plastics,* v. 23, Feb. '46, p. 156-162.

Drilled steam table; copper brazed steam table; arc welded steam table; poured steam table; choosing the correct steam table; general rules; adapters; guide pins; dowel pin substitutes; anchoring of steam table; hand molds; drawings; notebook for records.

23-53. **Portable Magnesium Gravity Conveyors.** M. M. Moyle. *Modern Metals,* v. 2, Feb. '46, p. 12-14.

Portable gravity conveyors are finding wide acceptance for applications where demand is for speedy transportation of materials requiring mechanical aids for handling in transfer. Magnesium conveyors are broadening this market. Service record; construction methods; advantages magnesium enjoys over steel for this application.

23-54. **Light Metals in a New Type Cruiser.** Karl Brocken. *Modern Metals,* v. 2, Feb. '46, p. 17-19.

Most of the engine parts made of aluminum or magnesium alloys. Also discusses a new type ventilating system which will be used and tells of some structural members wherein light metals will be the chosen material.

23-55. **The Aluminum Salvajor.** E. H. Benson. *Modern Metals,* v. 2, Feb. '46, p. 21-23.

Used for cleaning dishes in the kitchen of larger eating establishments. An appliance which clearly brings out the many advantages of aluminum, in addition to the fact that the original weight was reduced from 385 lb. to 85.

23-56. **Aluminum Clothespins.** *Modern Metals,* v. 2, Feb. '46, p. 24.

Made of aluminum wire and processed on a multi-slide wire-forming machine; pins are anodized in a variety of colors.

23-57. **Aluminum Airplane Hangar.** *Modern Metals,* v. 2, Feb. '46, p. 31.

Brief outline of a newly developed aircraft hangar which will be constructed of aluminum.

23-58. **Best for Test.** Robert E. Dillon. *Die Casting,* v. 4, Feb. '46, p. 21, 56.

In addition to reducing manufacturing costs, die castings meet the exacting requirements of dynamometer designed for laboratory work.

23-59. **The Selection of a Fabrication Method.** *Die Casting,* v. 4, Feb. '46, p. 28-30, 55-56.

How and why National Cash Register uses die castings—climatic conditions; stresses; wear.

23-60. **Geared to Power.** John L. Davies. *Die Casting,* v. 4, Feb. '46, p. 36-38.

Die-cast valves provide power control for shifting of two-speed axles, eliminating extra lever from the operator's cab and dispensing with the chassis rods and brackets, essential in manual control.

23-61. **Design for Small Quantity Production to Get the Maximum Advantages From Die Casting.** W. P. Uhler. *Die Casting,* v. 4, Feb. '46, p. 40-42, 44-48.

Use of die castings in the fabrication of dental equipment is significant because the practicability of manufacturing complicated parts requiring critical consideration of factors of stress, durability and operating characteristics has been demonstrated, even though quantities are small.

23-62. **Line-Up for Today's 1000.** A. R. Coleman. *Die Casting,* v. 4, Feb. '46, p. 60-62, 64, 66, 68.

Geared for quantity, production line turns out more then 1000 completed home washing machines each day. Efficient organization of finishing operations an important factor.

23-63. **Steel, Porcelain Enamel, and Concrete.** *Pencil Points,* v. 27, Feb. '46, p. 85-91.

Advantages of new technique for combining lightweight stock steel structural shapes with an exterior surface of porcelain-enameled steel pans backed with mesh-reinforced concrete.

23-64. **Designing with Beryllium-Copper for Spring Components.** R. W. Carson. *Electrical Manufacturing,* v. 37, Feb. '46, p. 129-131, 216.

Stress-relief hardening technique for beryllium-copper offers an important cost-reduction opportunity in making a variety of useful forms in production quantities. 3 ref.

23-65. **High Duty Gears.** *Automobile Engineer,* v. 36, Jan. '46, p. 39-41.

Highly loaded gears employed in aircraft work. The finer the pitch of the gears and the greater the pressure angle the greater will be the surface capacity. For still greater capacity, gears have been designed with finer pitch and unground shot-peened roots. (Paper presented to Society of Automotive Engineers.)

23-66. **Missouri Pacific Aluminum Hopper Cars.** *Railway Age,* v. 120, Feb. 2, '46, p. 270-272.

Weight saving of 13,000 lb. per car permits increased coal loading; reduced maintenance expense also expected.

23-67. **The Production of Track Links.** *Machinery,* v. 68, Jan. 31, '46, p. 137-145.

Forging, machining and assembly operations.

23-68. **Copper and Copper Alloys.** H. J. Miller. *Metallurgia,* v. 33, Jan. '46, p. 134-138.

Technical progress in 1945; continuous casting, new methods of rolling, production difficulties, developments of new alloys, the effects of minor elements in the established products, corrosion problems. 77 ref.

23-69. **Detroit Seamless Steel Tubes Co. Has for 45 Years Manufactured Steel Tubes.** Charles Longenecker. *Blast Furnace and Steel Plant,* v. 34, Feb. '46, p. 231-232.

Manufacturing processes; annealing and drawing.

23-70. **Powdered Glass for Better Seals to Metal.** *Instruments,* v. 19, Feb. '46, p. 89.

Method allows seals to be made under controlled conditions eliminating variations in oxidation, instead of depending upon the skill of the operator. After Kovar is powder-glass-coated it can be reheated to make the glass-to-glass seal without affecting the glass-to-metal seal, allowing less-skilled operators to do job. Method especially suited to the making of large and complex seals where it is difficult to prevent overoxidation of the Kovar by normal methods of sealing.

23-71. **Light Metals in the Laundry and Dry-Cleaning Industries.** *Light Metals,* v. 9, Feb. '46, p. 59-67.

Survey of the theory and practice of the uses of aluminum in industrial equipment for laundering. Reference is made to domestic apparatus. 1 ref.

23-72. **Roofing in Manganese-Aluminum.** *Light Metals,* v. 9, Feb. '46, p. 78-93.

Economic and practical advantages of Aluman for roofing; techniques of its use for this purpose.

23-73. **Missouri Pacific Buys Aluminum 70-Ton Hopper Cars.** *Railway Mechanical Engineer,* v. 120, Feb. '46, p. 62-64.

Entire body built of aluminum alloys except for the center sill and bolsters, which are carbon steel. Trucks and all specialties are made of steel except the Wine door frame, which is a 356-T6 aluminum alloy casting and the Dreadnaught pan doors made of 61S aluminum alloy pressings, heat treated after forming.

23-74. **Great Northern 50-Ton Drop-Bottom Gondolas.** *Railway Mechanical Engineer,* v. 120, Feb. '46, p. 68-71.

Cars embody all-welded low-alloy steel construction; weigh 42,000 lb. each; the doors have wide openings; for general service.

23-75. **Great Northern General Service Gondola.** *Railway Age,* Feb. 16, '46, p. 354-355.

Five hundred 50-ton drop-bottom cars designed for all-welded low-alloy steel construction; light weight, 42,000 lb.

23-76. **Some Materials and Methods for X-Ray and Power Tube Manufacture.** Charles F. Lindsay. *Materials and Methods,* v. 23, Feb. '46, p. 406-411.

Glass; copper; tungsten; sealing-in alloys; beryllium and tantalum; methods; testing.

23-77. **Magnesium-Cerium Alloy Castings for High Temperature Use.** R. F. Marande. *Materials and Methods,* v. 23, Feb. '46, p. 418-424.

Properties at elevated temperatures indicate magnesium-cerium alloys can be used for pistons and other parts. 11 ref.

23-78. **Brazed Stampings Basis of New Auto Engines.** Harold A. Knight. *Materials and Methods,* v. 23, Feb. '46, p. 438-440.

Automobile engine cylinder block is given strength and lightness by extensive use of copper-brazed steel stampings.

23-79. **Wrought Aluminum Alloys.** Owen Lee Mitchell. *Materials and Methods,* v. 23, Feb. '46, p. 448-466.

Available forms; mechanical and physical properties; corrosion and chemical resistance; forming and drawing characteristics; machining; methods of joining; finishes.

23-80. **Metallurgical Aspects of X-Ray Tube Manufacture.** M. J. Zunick. *Canadian Metals and Metallurgical Industries,* v. 9, Feb. '46, p. 32-34, 36, 41.

Physical requirements of an X-ray tube; X-ray tube anode; X-ray tube cathode; glass to metal seals; exhausting X-ray tubes. 11 ref.

23-81. **Greatly Increased Use of Stainless Steel Stampings Predicted.** *Steel Processing,* v. 32, Feb. '46, p. 104-105, 133.

This year will find stainless steel stampings extensively used in equipment for industries such as food; brewing; paper and pulp; oil refining; dairy; chemical; textile; transportation including ship, automobile and railroad; building; and household cooking utensils and appliances. Stainless steel offers great advantage of easy cleanability; can be kept sterile more readily than most other metals; resists corrosion over long periods of time; highly resistant to abrasion.

23-82. **Present and Future Uses of Magnesium in the Textile Industry.** *Aluminum and Magnesium,* v. 2, Feb. '46, p. 16-17, 26-27.

Lightness and strength; stiffness; dimensional stability; resilience; resistance to corrosion and wear; fabrication qualities; maintenance cost; magnesium in spinning, twisting and winding machines; magnesium tricot warp beams; magnesium section beams; magnesium in looms; magnesium in hosiery and warp knitting machines.

23-83. **High Strength Aluminum Alloys.** R. A. Miller and M. E. Tatman. *Metal Industry,* v. 68, Feb. 15, '46, p. 123-125.

Results of a study to determine how best to fabricate aircraft components made from precipitation hardening aluminum alloys so as to take full advantage of the superior mechanical properties and yet have parts that can be fabricated readily with a minimum of shop difficulties are dealt with. (Paper presented to Society of Automotive Engineers.)

23-84. **Nickel and High Nickel Alloys.** H. O. Teeple. *Paper Industry and Paper World,* v. 27, Jan. '46, p. 1523-1529.

Use in the pulp and paper industry.

23-85. **Aluminum and the Building Program.** George Mortimer. *Metallurgia,* v. 33, Feb. '46, p. 189-192.

How Britain's aluminum reserves can be effectively used to alleviate scarcity of building materials.

23-86. **Trends in Tools and Die Steels.** G. N. Moffat. *Ohio State University Engineering Experiment Station News,* v. 18, Feb. '46, p. 13-16.

Successful use and established position of the high molybdenum, low tungsten grades of high speed steels.

23-87. **Die Castings in the Science Class.** *Die Casting,* v. 4, March '46, p. 40-42, 44-50.

Vacuum pumps; rotator; centripetal force apparatus; agate-bearing trip scales with redesigned beam; Brownian

movement apparatus; aluminum alloy telescope clamp; Zeleny electroscope in aluminum alloy; carriage non-tilting or hinged types base; Dekhotinsky thermo regulator and bi-metallic thermo regulators; optical object box in aluminum alloy; eye model; hot cone heater; radiation thermopile; tubular rheostat.

23-88. **Small Power Plants.** *Die Casting,* v. 4, March '46, p. 20-22, 55-56.

Aluminum die castings for model airplane engines insure higher tensile strength, elimination of blowholes, reduction of machining operations, and greater uniformity of parts.

23-89. **Bonded Gaskets Solve Sealing Problems in Die Cast Assemblies.** E. A. Sprigg. *Die Casting,* v. 4, March '46, p. 70-72.

Use of molded synthetic rubber gaskets provides means of eliminating extra handling operations in assemblies where a gasket member is required for sealing.

23-90. **High Strength Screws From Low Carbon Steel.** George F. Meyer. *Wire and Wire Products,* v. 21, March '46, p. 225-227.

Development of cold heading wire in the chemical range of 0.18 to 0.23% carbon and 0.50 to 1.00% manganese has progressed to the point where the largest users of heat treated screws not only accept, but in many cases, specify its use.

23-91. **Tellurium-Bearing Copper.** *Metal Industry,* v. 68, March 1, '46, p. 174.

Development of free-cutting high-conductivity rod for electrical contacts.

23-92. **Industrial Significance of the Basic Characteristics of Magnesium.** J. D. Hanawalt. *Metal Progress,* v. 49, March '46, p. 548-552.

German magnesium industry; various aspects of the economies of processing magnesium.

23-93. **Cesium: Light Metal for Electronics.** C. C. Legal, Jr. *Light Metal Age,* v. 4, Feb. '46, p. 15-17.

Industrial cesium; industrial uses; historical background; properties; sources; preparation of cesium; the future for cesium. 7 ref.

23-94. **Copper-Base Alloys for Special Electrical Appliances.** Arthur L. Clark. *Electrical Manufacturing,* v. 37, March '46, p. 112-114, 228.

The phosphor, aluminum, and silicon bronzes, among others, have properties peculiarly fitting them for specification in contact springs; other current-carrying and corrosion and fatigue resisting applications.

23-95. **High-Pressure Valves.** *Steel,* v. 118, March 18, '46, p. 120.

Pointed at improving pressure-seal bonnet joints, reducing weight, aiding disassembly.

23-96. **Advances in Water-Cooled Cable.** Myron Zucker. *Welding Engineer,* v. 31, March '46, p. 54-57, 59.

Low-reactance water-cooled resistance welding cable; advantages of newest type of "kickless" cable.

23-97. **Fabricating and Finishing of Aluminum and Its Alloys.** G. M. Young. *Canadian Metals and Metallurgical Industries,* v. 9, March '46, p. 20-26, 36.

Forming by bending, stretching, and drawing; joining by riveting, welding, brazing, soldering; table gives fabricating properties of aluminum alloys.

23-98. **The Aluminum Blitz Can.** A. B. Carlson. *Modern Metals,* v. 2, March '46 p. 6-7.

Aluminum can weighs only half as much as a steel can and requires no inside coating.

23-99. **Aluminum in the Coal Gas Industry.** *Aluminum and Magnesium,* v. 2, March '46, p. 18-19, 25-26.

Aluminum is resistant to oxidation at certain elevated temperatures commonly met in the production and consumption of coal gas and to tarnishing at ordinary temperatures; has good heat conductivity and low emissivity; may be obtained in numerous attractive finishes; fabricates easily and has good resistance to the corrosive fumes and liquors indigenous to the production of coal gas and to the products of gas consumption.

23-100. **Nut Blanks From Plates, Bars and Rods.** A. M. Smith. *Fasteners,* v. 3, no. 2, '46, p. 10-13.

Method of making a nut depends on size and type of nut as well as the material and the economy factors of the equipment available.

23-101. **Light Metals in the Food and Allied Industries.** *Light Metals,* v. 9, March '46, p. 111-128.

General chemical suitability of aluminum and aluminum-alloy plant for food processing and handling; special attention is directed to health considerations involved.

23-102. **Light Metals in the Bleaching and Dyeing Industries.** *Light Metals,* v. 9, March '46, p. 129-138.

Survey of theory and practice of the use of aluminum in textile manufacture and processing.

23-103. **New 12-Ft. Runabout in Light Alloy.** *Light Metals,* v. 9, March '46, p. 139-141.

Weight of 12-ft. aluminum boat is 319 lb. Constructed in Burmabright—an alloy which combines high mechanical strength with exceptionally high resistance to corrosion, even in sea water. Dimensions, weights, engine unit.

23-104. **Light Alloys in Rectifiers, Photocells and Condensers.** *Light Metals,* v. 9, March '46, p. 144-151.

Operations in manufacture of fixed paper condensers are further considered with special reference to the manipulation of the foil and impregnation of paper.

23-105. **Machine Tool Metallurgy.** E. G. Green. *Western Metals,* v. 4, March '46, p. 15-17.

Types of materials and treatments entering into the manufacture of modern machine tools.

23-106. **Light Steel and Prefabrication Speeds Plant Construction.** *Western Metals,* v. 4, March '46, p. 18-19.

Unique method of light steel construction effected im-

portant savings in the nearly completed, 40,000-sq.ft. plant of Electric Household Utilities Corp. Standard modules or units of light steel are assembled in the Pasadena plant of Latisteel, Inc., and are ready for erection at the site. Such units are fabricated for the complete building for all parts above the floor slab.

23-107. **Materials and the Postwar World.** J. C. DeHaven. *Foundry,* v. 74, April '46, p. 97, 200-201.

Development of many new and improved products has been made possible largely because of research and betterments in materials and methods. High-temperature alloys for gas turbines; precision casting, aluminum piano plates.

23-108. **Die Castings in the Hardware Industry.** *Die Casting,* v. 4, April '46, p. 24-26, 49-51.

Locks; hinges; handles; pulleys; brackets; power transmitting elements; expansion bolts; hose elements; door checks; drain fittings.

23-109. **A Metallurgical Study of German Aircraft Engine and Airframe Parts. Section XIII—Airframe Components; Section XIV—Miscellaneous Parts.** *Metallurgia,* v. 33, March '46, p. 253-260.

Constitutes a summary of further data resulting from the metallurgical examination of German aircraft engine and airframe parts by the Aero-Components Subcommittee of the Technical Advisory Committee of the Special Alloy Steel Committee formed for that purpose. Parts of undercarriages, control systems. Cannon, armor plate, seat support, bomb release unit, door hinge, window frame, bracket.

23-110. **Metallurgical Aspects of X-Ray Tube Manufacture.** M. J. Zunick. *Iron Age,* v. 157, April 11, '46, p. 56-59.

Some of the unusual operations involved in X-ray tube manufacture, including casting of anodes, mounting of the filament, preparation of targets, glass-to-metal sealing and tube exhausting are discussed; some interesting notes on preferential heating characteristics of vacuum furnaces included. 11 ref.

23-111. **New Type Chromium-Nickel Alloy Offers Wider Range of Refinery Applications.** John S. Ewing. *National Petroleum News,* v. 38, April 3, '46, p. R-243-R-246.

Wider use in refineries and gasoline plants generally is likely to result from improvements in the design of stainless steel bubble caps. These keep weight of equipment to a minimum while resistance to corrosion and the toughness of the metal greatly decrease breakage. Improved methods also are now in use for applying stainless steel linings to vessels and overlays to exposed steel surfaces for corrosion protection.

23-112. **Aluminum and Magnesium in the Electrical Industries.** *Light Metals,* v. 9, March '46, p. 163-166.

Use of aluminum foil in fixed paper condensers.

23-113. **Geon in the Wire and Cable Industry.** Geo. A. Fowles. *Rubber Age,* v. 58, March '46, p. 703-708.

Description of production of polyvinyl chloride, its

plasticization, and method of coating wire with this plasticized material.

23-114. **Magnesium Alloys for Aircraft. Part I.** F. A. Rappleyea. *Aero Digest,* v. 52, April '46, p. 79-81.

Compares magnesium alloys with the commonly used aircraft structural materials, not only using fundamental principles of design, but also, wherever possible, the actual structures. In general, comparisons of structures include only the commonly used 24S-T aluminum alloy. However, all the new high-strength aluminum alloys such as clad 75S-T, R301T, etc., and steels are considered in the comparison of fundamental design principles.

23-115. **USS Builds All-Welded Cor-Ten Hopper.** *Railway Age,* v. 120, April 6, '46, p. 722-723.

Design based on study of 65,000 Cor-Ten cars now in service; outside frame and welded fabrication reduce opportunities for corrosion.

23-116. **Laying Steel Floor Plates the Right Way.** C. P. Closkey. *Factory Management and Maintenance,* v. 104, April '46, p. 110.

Bedding coat between the steel plates and the wood floor eliminates curling, buckling, and crawling of the plates, and reduces noise of traffic passing over the nonskid pattern. Also is efficient shock absorber, and allows plates to be securely bound to the old floor with less than half the customary number of fastening screws. Material consists of an asphalt binder emulsion and a dry aggregate of rock asphalt.

23-117. **Postwar Horizons for Cast Alloys.** Wallace A. Scotten. *Production Engineering and Management,* v. 17, April '46, p. 139-141.

Precision casting supercharger buckets; other high-temperature alloys; applications suggested; many uses predicted; cutting tools; milling cutters.

23-118. **The Production of Hairpins and Bobbie Pins.** Ethelyn Weller. *Wire and Wire Products,* v. 21, April '46, p. 295-297.

Production facilities and methods of a large manufacturer. Machines used are specially built.

23-119. **Copper and Copper Alloy Springs.** *Wire and Wire Products,* v. 21, April '46, p. 299-306, 326.

Knowledge required for satisfactory design and production of copper springs; advantages over steel springs; design of flat springs, helical springs, torsion springs, miscellaneous springs. 66 ref.

23-120. **Aluminum Portable Washing Machine.** *Modern Metals,* v. 2, April '46, p. 19.

Novel type of washing machine called the "Electro-Mite". Considerable aluminum is used in the 18-lb., two-unit washer.

23-121. **Manufacture of Welding Electrodes.** *Machinery,* v. 52, April '46, p. 152-155.

"Ni-rod" and other electrodes made on a production line having a capacity of over 1000 lb. per hour at the Bayonne, N. J., works of the International Nickel Co.

23-122. **The Tools and Techniques for the Production of Precision Gears, IV.** *Tool Engineer,* v. 16, April '46, p. 26-35.

Power formulas for spur and helical gear design; gear inspection.

23-123. **Silicones—Truly New Materials for Industry.** *Steel,* v. 118, April 22, '46, p. 78-83, 118, 121-122.

High-temperature electrical insulation, water resistant surface treatment, low-temperature lubrication, fluid for diffusion pumps and heat-stable rubber applications are among uses for versatile materials.

23-124. **Heat Resisting Alloys for Motor-Car Gas Producers.** J. Sissener. *Foundry Trade Journal,* v. 78, March 28, '46, p. 341-345.

Details of experiments undertaken to improve the life of heat resisting castings used in wood-burning gas producers for wartime automobiles in Norway.

23-125. **Aluminum in Shipbuilding.** *Light Metals,* v. 9, April '46, p. 180-206.

Elementary theory and practice of ship construction in light metals, with an analysis of economic advantages. 35 ref.

23-126. **Steels for the Plastics Industry.** *British Plastics,* v. 18, March '46, p. 109-114.

The wide extension of the use of plastics has inevitably led to an increased demand for toolsteels capable of making pressed and molded objects from such materials as bakelite. An attempt is made to outline the principal steels now being employed for these exacting requirements.

23-127. **Production of Torsion Bars for Buick "Hell-Cat" Suspension at Spencer Mfg. Co. Plant Involves Unusual Techniques.** *Industrial Heating,* v. 13, April '46, p. 592-594, 596, 598, 600, 602, 604, 606, 608.

23-128. **Brass Press Forgings or Die Castings—Which?** Herbert Chase. *Materials & Methods,* v. 23, April '46, p. 995-1000.

With the exception of alloys, which are quite similar, many design and physical factors affect the choice of method for producing brass parts. These include size and weight; density and grain structure; physical properties; design; production rates and labor costs; section thickness, holes and recesses; working temperatures; degree of smoothness; tooling costs; dimensional tolerances; flash thickness and location; scrap losses; inserts; fillets, corners and threads; teeth, serrations and lettering; machinability.

23-129. **Engineering Bronzes.** Kenneth Rose. *Materials & Methods,* v. 23, April '46, p. 1028-1042.

General classifications; nonhardenable bronzes; hardenable bronzes; fabricating the engineering bronzes; forms and finishes.

23-130. **Vanadium Data Sheet: Wrought Constructional Steels in Light Sections. Part I.** T. W. Merrill. *Vancoram Review,* v. 4, Fall-Winter '45-46, p. 14-15.

Principal wrought chromium-vanadium steel compositions, including not only their heat treatment and me-

chanical properties but other essentials concerned with their application to various articles of manufacture.

23-131. **Aluminum and Its Alloys in Canning.** T. D. Smith. *Sheet Metal Industries,* v. 23, April '46, p. 699-706.

Continental practice; advantages of aluminum as a canning material; alleged toxicity of aluminum; aluminum and alloys for canning; fabrication; pressing; press forming; bending; impact extrusion; Hooker process of impact extrusion; joining aluminum and aluminum alloys; seal welding; synthetic plastic adhesives; protecting aluminum cans.

23-132. **Light Alloys in Rectifiers, Photocells and Condensers.** *Light Metals,* v. 9, April '46, p. 215-220.

Final stages in the production of fixed condensers.

23-133. **New Housing to Use Light Metals.** *Aluminum and Magnesium,* v. 2, April '46, p. 18-20.

Fuller house could constitute one of the largest single markets for aluminum. How moving aluminum shelves operate; aluminum gives thermal efficiency; aluminum ceiling conserves heat; house and floor weigh only 3 tons.

23-134. **Aluminum Roof on Railway Terminal.** *Sheet Metal Worker,* v. 37, April '46, p. 46-48, 70.

Application of 65,000 lb. of aluminum to dome, two arched roofs and three parapet walls of the Cincinnati Union Terminal writes a new chapter in aluminum roofing history.

23-135. **Versatility of the Ball.** H. F. Williams. *Machine Tool Blue Book,* v. 42, May '46, p. 181-190.

Résumé of a recent series of articles, including some additional applications.

23-136. **Die Castings Come Through in the Clutch.** *Die Casting,* v. 4, May '46, p. 29-32.

By changing clutch wheel support from sand casting to die casting, increased accuracy, reduced machining, and simplified assembly gained.

23-137. **Check on Die Castings.** *Die Casting,* v. 4, May '46, p. 36-38.

An undercut interior with light weight, rigid walls is obtained by die castings used in check protectors.

23-138. **Product Design With Die Castings—Portable Lubricating Equipment.** *Die Casting,* v. 4, May '46, p. 40-44.

Die castings in place of screw machine and stamped parts in this equipment not only reduced manufacturing costs, improved appearance, but made possible an entirely new lubricating principle.

23-139. **Equipment for Steel Wool Manufacture.** *Machinery,* v. 52, May '46, p. 165-167.

Several thousand steel strands are cut simultaneously from small wire by almost 600 tools. Such machines will convert 10 miles of steel wire into steel wool every 6 hr.

23-140. **An Aluminum Spring May Be the Answer.** Amiel Gelb. *Machine Design,* v. 18, May '46, p. 137-140, 178.

Experimental data presented to aid designer in deter-

mining the applicability of a new aluminum alloy, R303, for employment in springs.

23-141. **Copper and Copper Alloy Springs, Part II.** *Wire and Wire Products,* v. 21, May '46, p. 382-386, 395-400.
Manufacture of springs. Springs made from flat strip; helical springs; spiral springs.

23-142. **U.S.S. Designs All-Welded Cor-Ten Hopper.** *Railway Mechanical Engineer,* v. 120, May '46, p. 254-256.
New types of joints embodied in the construction are all welded and simplify construction, provide tight seals against moisture, and eliminate laps. New all-welded car weighs only 33,500 lb., a saving of 6540 lb. over the A.A.R. standard hopper car built of carbon steel.

23-143. **Metallurgical Aspects of X-Ray Tube Manufacture.** M. J. Zunick. *Glass Industry,* v. 27, May '46, p. 238-241, 260.
Physical requirements of an X-ray tube, cathodes, anodes, and glass-to-metal seals.

23-144. **Unfamiliar Uses of Bronze.** George K. Dreher. *Western Metals,* v. 4, May '46, p. 23-27.
Alloys of post World War I era; alloys now available.

23-145. **Application of Magnesium Alloys.** D. A. Tooley. *Machinery (London),* v. 68, April 25, '46, p. 527-530.
Some disadvantages of magnesium alloys; production methods; chemical treatment and paint desirable to prevent corrosion.

23-146. **Light Alloys in Rectifiers, Photocells, and Condensers.** *Light Metals,* v. 9, May '46, p. 231-235.
Materials employed in the sealing and potting of fixed paper condensers.

23-147. **Two Million Lining Bolts.** Spencer Jones. *Fasteners,* v. 3, May '46, p. 14-16.
Details of circular cast-iron segments bolted together with steel bolts more than 40 years ago in Hudson River tunnels. Such a lining is permanently watertight as soon as it is bolted up.

23-148. **The Metallurgy of the Jeep.** Roger F. Mather. *Metallurgia,* v. 33, April '46, p. 283-286.
Materials versus design; testing; material specifications; plain carbon steel forgings.

23-149. **Cast Iron in Contemporary Building and Engineering.** J. G. Pearce. *Metallurgia,* v. 33, April '46, p. 311-312.
Survey of the early development of cast iron as a structural material; its manufacture and uses.

23-150. **Pressure Vessels Made With Welded Nickel Alloy Linings.** T. H. Menaugh. *Materials & Methods,* v. 23, May '46, p. 1289-1292.
Manufacture of a 63-ft. long pressure vessel that can withstand high temperatures and pressures as well as corrosive acids. Made of steel plate lined with Hastelloy B (62% nickel, 6% iron, 1% manganese, 30% molybdenum, 1% silicon). Ten general rules for lining vessels with this alloy.

23-151. **Precision Production of Steel Aircraft Gears.** Orlo E. Brown. *Materials & Methods,* v. 23, May '46, p. 1303-1306.

Control of material; control in machining; control in heat treating. Gives a few typical heat treating cycles which illustrate how different types of gears are handled.

23-152. **Metals and Alloys in the Petroleum Industry.** John H. Wilson. *Journal of the Institute of Petroleum,* v. 32, April '46, p. 230-240.

General article describing properties of various alloys commonly used in refining and other applications in the petroleum industry.

23-153. **Aluminum and Its Alloys in Canning.** T. D. Smith. *Sheet Metal Industries,* v. 23, May '46, p. 909-910, 912.

Normal canning procedure and modification suggested for aluminum canning; examples of the use of aluminum and aluminum alloys for canning.

23-154. **Chemical and Metallurgical Control in Machine Tool Manufacture.** D. G. P. Paterson. *Sheet Metal Industries,* v. 23, May '46, p. 925-932.

Laboratory control of materials and processes involved in the production of machine tools is concerned with: routine testing of materials to ensure uniformity and adherence to specification; establishing satisfactory heat treatment conditions and providing relevant information for works use; inspection of certain finished products; investigation of production difficulties and troubles due to materials or heat treatment; examination of new manufacturing methods and testing techniques; research work on development and service conditions of machine tools.

23-155. **Trends in Aluminum.** *Canadian Metals & Metallurgical Industries,* v. 9, May '46, p. 32, 34.

Past developments, present difficulties and potential possibilities.

23-156. **Stainless Steels for Turbine Blading.** J. H. G. Monypenny. *Steel Processing,* v. 8, May '46, p. 309-313, 324.

Corrosion resistance is one of the most important factors. Strength, ductility, toughness at atmospheric and at operating temperatures discussed together with the effects of prolonged exposure at the latter temperatures. Response of the various steels to fabrication methods. How their essential properties differ from those of stainless iron. Comparison with monel metal.

23-157. **Sapphire as a Production Tool.** Roger F. Waindle. *American Machinist,* v. 90, June 6, '46, p. 101-104.

War-developed synthetic jewel has a variety of metalworking applications because of its high hardness. Its characteristics and properties are summarized.

23-158. **Deep Well Turbine Pump Production Practices.** C. D. Bower. *Western Machinery and Steel World,* v. 37, May '46, p. 230-235.

Covers problems involved in the manufacture of wide variety of parts.

23-159. **Metallurgical Control in Gear Manufacturing.** Orlo E. Brown. *Western Machinery and Steel World,* v. 37, May '46, p. 239-241.

How it is possible, through constant technical control, to reach and hold high standards of manufacture.

23-160. **The Metallurgy of the Jeep.** Roger F. Mather. *Metallurgia,* v. 34, May '46, p. 9-14.

Through-hardening alloy steel forgings; carburized alloy steel forgings; bolts, screws and studs; sheet metal parts; castings; bearings, bushings, and thrust washers; surface treatments for strength and wear resistance.

23-161. **Aluminum Alloy Scaffolding.** G. O. Taylor. *Metallurgia,* v. 34, May '46, p. 15-17.

Use of standard alloys in various finished and semi-finished forms for tubular scaffolding. Gives series of loading tests carried out by Northern Aluminium Co., Ltd.

23-162. **Cast Iron in the Chemical Industries.** F. L. LaQue. *Metal Treatment,* v. 8, Spring '46, p. 21-24.

Factors dictating choice of cast iron; corrosion resistance a governing factor; irons resistant to highly active acids; applications in many industries; pumps, pipes, valves, and fittings.

23-163. **Magnesium Appliance Mover.** L. M. Oldt. *Modern Metals,* v. 2, June '46, p. 10-13.

Mechanics of a load mover; design changes; fabrication methods; cost comparison.

23-164. **Kirksite "A" for Tooling.** W. W. Richmond. *Modern Metals,* v. 2, June '46, p. 21-24.

Typical applications; tool production figures; physical properties; cost comparisons between Kirksite and steel tooling; some fields where this tool material will find application.

23-165. **Light Metals Engine.** *Modern Metals,* v. 2, June '46, p. 28-29.

The part light metals will play in development of the Jack & Heintz internal combustion engine.

23-166. **Centrifugal Pump Design.** *Die Casting,* v. 4, June '46, p. 24, 27.

Bendix washer pump is constructed of unprotected zinc alloy die-cast parts which successfully resist the corrosive action of hot, alkaline wash water.

23-167. **The Development of Magnesium Alloys as Aircraft Materials.** J. C. DeHaven. *Western Metals,* v. 4, June '46, p. 15-19.

Early materials; all-metal planes; influence of impurities; low-impurity castings; melting practice; temperature applications; substitutions; rolling and heating.

23-168. **Heat Treated Rivets for High Strength Joints.** N. L. Marvin. *Materials & Methods,* v. 23, June '46, p. 1574-1577.

Combination of heat treated alloy steel body and deformable aluminum collar provides new type rivet with the high strength needed for many applications.

23-169. **Impact Resistance, Dimensional Stability, Production Economy, Intricate Structure in a Redesigned Drill Head.** *Die Casting,* v. 4, June '46, p. 22-23, 41.

Description of drill head for multiple-spindle drilling

and slotting machine used widely in the paper industry. Zinc alloy die casting has been substituted for former cast-iron unit.

23-170. **Station Dome Gets New Aluminum Cover.** *Railway Age,* v. 120, June 1, '46, p. 1109-1111.

Recent installation at Cincinnati Union Terminal demonstrates how a light, water-tight, freely expanding roof can be applied, even on a spherical surface, by good design, prefabrication and surface preparation.

23-171. **Product Designs. Magnesium Castings for Lightweight Portable Engine-Driven Chain Saw.** *Product Engineering,* v. 17, June '46, p. 452-454.

Saw available in 24, 36, 48, 60, and 72-in. capacities. Can be adjusted to cut vertically or horizontally by adjusting an index lever. Saw guide plate is reversible endwise and sidewise, thus giving a greater wearing surface.

23-172. **Aluminum Fabrication.** *Metal Industry,* v. 68, June 7, '46, p. 449-450.

Methods and equipment employed by Hettstedt Works of Mansfeld A. G. in Germany. Pressure for wartime production appears to have stifled new development and put restraints of many kinds on natural evolution.

23-173. **Shaped Wire and Its Applications.** Vincent H. Godfrey. *Steel,* v. 118, June 24, '46, p. 90-91.

High accuracy of size, smooth surface, and relatively low cost of producing almost any conceivable cross section makes shaped wire highly attractive to its users.

23-174. **"Packet" Canoe in Aluminum.** W. J. Passingham. *Light Metals,* v. 9, June '46, p. 293-294.

A truly portable two-seater weighing 36 lb.

23-175. **Use of Cemented Carbides in Steel Processing.** Fred Hennig. *Steel Processing,* v. 32, June '46, p. 379-382.

Mill rolls; dies; other direct applications of carbide; deburring files; bearings; ball check valves and seats; recent tooling applications of carbides.

23-176. **Aluminum and Magnesium in the Electrical Industries.** B. J. Brajnikoff. *Light Metals,* v. 9, June '46, p. 295-301.

Recent Russian work in connection with the substitution of aluminum foil for tin and other foils in fixed paper condensers.

23-177. **Light Alloys in Organ Construction.** F. A. Allen and F. Joynson. *Light Metals,* v. 9, June '46, p. 302-305.

Mechanics of the organ; how advantage can be taken of many valuable properties of aluminum and magnesium in order to advance its development.

23-178. **Ships' Superstructures in Light Alloys.** W. Muckle. *Light Metals,* v. 9, June '46, p. 306-311.

Results of investigations carried out on a number of different types of vessel to ascertain the influence of replacing existing steel superstructural and upper structural members with light alloys.

23-179. **Light Alloys in Rectifiers, Photocells and Condensers.** *Light Metals,* v. 9, June '46, p. 318-325.

Practical considerations of the final production stages in condenser manufacture.

23-180. **Lightweight Freight Cars a Corrective for High Tare.** A. F. Steubing. *Railway Mechanical Engineer,* v. 120, June '46, p. 292-294, 298.

Review of upward trend in car capacity since 1920 which was accompanied by a slight reduction in average car load; high-strength steel for lightweight construction offers means of preventing resumption of former trend during postwar years.

23-181. **Copper and Copper Alloy Springs. Part III—Characteristics of Spring Materials.** *Wire and Wire Products,* v. 21, June '46, p. 456-460, 476-477.

Mechanical and physical properties, fatigue, maximum operating temperature and corrosion resistance.

23-182. **Industrial Significance of the Basic Characteristics of Magnesium.** J. D. Hanawalt. *Western Metals,* v. 4, June '46, p. 28-31.

A review of the properties of magnesium and the economics of its use which make it attractive to the design engineer. (Reprinted from *Metal Progress.*)

23-183. **A Record Turnover.** *Die Casting,* v. 4, July '46, p. 24-26, 46-48.

Some of major die-cast structural and mechanical components in new Capehart automatic record changer are of unusual size. Method of production not only meets high quality standards of instrument, but is an important factor in reducing manufacturing costs.

23-184. **Metallurgical Aspects of X-Ray Tube Manufacture.** M. J. Zunick. *Instrument Maker,* v. 14, May-June '46, p. 26-32.

The physical requirements of an X-ray tube are exceptionally severe, and those of interest from a metallurgical standpoint are: density and melting point of targets and anode castings which have a direct bearing on loading and heat transfer; purity of metals with respect to both metal impurities and absence of gases; cleanliness of all surfaces and avoidance of low melting metal impurities; and chemical composition especially in the case of low-expansion metal sleeves.

23-185. **Rail Mills and Rail Mill Roll Design.** Ross E. Beynon. *Iron and Steel Engineer,* v. 23, June '46, p. 53-80.

Early rail mills; present types of rail mills; rail straightening; furnaces and charging and drawing mechanisms; controlled cooling; housings; mill tables; rolls for rail mills; roll designing; rail blooming; two-high versus three-high mill rail pass design; streetcar rails; foreign designs of T-rail passes; light rails; angle splice bars; continuous rail joints.

23-186. **Steel in Modern Building Construction.** Carl F. Block. *Steel,* v. 119, July 8, '46, p. 98-101, 127, 130.

Application of mass-production techniques in turning out lightweight steel sections expected to extend market in both commercial and residential fields. Corrosion sel-

dom a problem where proper design factors are taken into account.

23-187. **Diesel Engines—Materials for Bearings and Crankshafts.** C. C. Hodgson. *Iron and Steel,* v. 19, June '46, p. 382.

Current practice; bearing development; advantages of nitriding. (Paper for Sheffield Metallurgical Association.)

23-188. **Highlighting the 1946 Cars.** *Die Casting,* v. 4, July '46, p. 18-20.

Mechanical and structural parts, though seldom exposed to view, often cost less and serve their purposes well when die cast. Shown are parts of oil seals, fuel pumps, carburetors, windshield wiper and lock parts.

23-189. **An Oscillating Fan: Design for Minimum Assembly.** Milton W. Weber. *Die Casting,* v. 4, July '46, p. 34-39.

By use of die castings a product is achieved requiring a minimum of pre-assembly operations, fewer and simpler assembly operations, and a greater degree of dimensional accuracy.

23-190. **Hydraulic Equipment, Part II.** J. A. Oates. *Aircraft Production,* v. 8, June '46, p. 267-275.

Describes production of the Purolator fuel oil filter, which makes use of coiled wire of special section as the filtering medium. Deals with some of the more interesting types of fixtures used when machining undercarriage components. Application of the Colourdex system to machine loading and job control.

23-191. **Aluminum Panels and Lining for Trailers.** *Modern Metals,* v. 2, July '46, p. 10-11.

Advantages. Table gives weight savings of aluminum panels and lining vs. steel panels and plywood lining.

23-192. **Aluminum Grating.** H. J. Thelen. *Modern Metals,* v. 2, July '46, p. 24-25.

New type gratings have interlocking bridges and nonslip surfaces. They are resistant to corrosion; do not require a paint coating; are sparkproof and lightweight. Wide application in chemical plants, on bridges and in public walkways. Additional uses are being found where there is a constant grating removal problem and where the advantages of reduced weight are a factor.

23-193. **Light Metals Fastener.** *Modern Metals,* v. 2, July '46, p. 26-27.

Huck Lockbolt is made of strong aluminum alloy and combines advantages of both bolts and rivets. Advantages are described; operating principles and types available.

23-194. **Profiting From War Production Experience at Ford of Canada.** Joseph Geschelin. *Automotive and Aviation Industries,* v. 95, July 1, '46, p. 22-25, 64.

Valve push rod or tappet made as a fabricated assembly offers unique case study of a mass-production process replacing conventional methods with resulting improvement in cost and serviceability.

23-195. **Plate Metal and Grain Standardization.** S. A. Sheridan. *Modern Lithography,* v. 14, July '46, p. 30-35.

Measurements of grain depths and size and microscopic observations have been recorded and reported upon samples of grained plate, both zinc and aluminum. Tentative specifications for zinc sheet intended for mechanically grained litho plates.

23-196. **Railworthy Wheel-Making at Armco's Butler Steel Plant.** *Steel,* v. 119, July 15, '46, p. 106-110, 136-138.

How a wrought steel wheel of low internal stresses is produced from ingot to finished product. Details of forging, heat treating and rolling practices.

23-197. **Pumps for Use With Acids.** J. Sprecher. *Engineers' Digest (American Edition),* v. 3, June '46, p. 277-278.

Gives constructional details of acid pumps made of stoneware with outer cast-iron parts and gland and glandless type pumps. (Abstract from *Technische Rundschau Sulzer,* no. 3, 1945, p. 1-9.)

23-198. **Selection of Cold Work Die Steels.** G. M. Butler. *Tool & Die Journal,* v. 12, July '46, p. 98-102.

Comparison of the various steels generally available for dies for cold work, with emphasis on the properties of each steel which may fit it to particular needs. Water hardening steels; oil hardening steels; air hardening steels.

23-199. **Copper and Copper Alloy Springs. Part IV—Behavior of Springs.** *Wire and Wire Products,* v. 21, July '46, p. 527-533, 559.

Stability at normal temperatures; change of modulus with stress; aging; movement of zero position; hysteresis; aftereffect; effect of elevated temperatures.

23-200. **New Engine.** *Machine Design,* v. 18, July '46, p. 125-128.

The recently developed Jack & Heintz Precision Industries engine incorporates many novel features including slide valves, built-up crankshaft and generous use of die-cast light metals.

23-201. **Superalloys for High Temperature Service in Gas Turbines and Jet Engines.** F. S. Badger, H. C. Cross, C. T. Evans, Jr., Russell Franks, R. B. Johnson, N. L. Mochel, Gunther Mohling. *Metal Progress,* v. 50, July '46, p. 97-122.

Verbatim report of a round-table discussion at American Society for Metals' National Metal Congress. Operating characteristics of a power turbine and the high temperature problems encountered; metallurgical problems in combustion chamber and duct work; diaphragm sections for the aircraft supercharger; turbine wheels and buckets. Detailed descriptions of various old and new alloys, their properties and applications in this field. Includes tables, illustrations, graphs.

23-202. **Metallurgy and the Development of the High-Speed Diesel Engine.** C. C. Hodgson. *Metallurgia,* v. 34, June '46, p. 69-76.

Brief description of the type of engine and its characteristics. Cast iron for cylinder head and block and for crankcase; light alloys for pistons; valve steels; bearing developments; nitrided crankshafts; Izod impact values and inclusions.

23-203. **Nickel Steel Driving Rods.** *Railway Mechanical Engineer,* v. 120, July '46, p. 358-363.

Close control of forging and heat treating temperatures and rates of heating is essential. Tool marks are removed from the finished rods by polishing.

23-204. **The Gas Turbine in Industry.** J. R. Carlson. *Blast Furnace and Steel Plant,* v. 34, July '46, p. 874-878.

Review of developments which are making the gas turbine possible for use in the aircraft industry, railroad drives, maritime industry, and central station applications.

23-205. **Making the Fordson Plough.** *Machinery (London),* v. 69, July 11. '46, p. 33-39.

Iron and steel melting arrangements; the core shop; cleaning, fettling, assembly, and painting.

23-206. **Lightweight Motors Built of Large Aluminum Die Castings.** Kenneth Rose. *Materials & Methods,* v. 24, July '46, p. 83-86.

Die castings replace aluminum sand castings for many of the large parts of 2, 4, and 6-cylinder aircraft-type internal combustion engines.

23-207. **Applications of Aluminum.** *Light Metals,* v. 9, July '46, p. 343-347, 349-354.

Bibliography of articles on the applications of aluminum and magnesium and their light alloys which have appeared in *Light Metals,* Feb. 1938, to May 1946.

23-208. **Light Alloys in Rectifiers, Photocells and Condensers. (Continued.)** *Light Metals,* v. 9, July '46, p. 372-378.

Finishing processes in the manufacture of fixed paper condensers; certain more recent developments with respect to dielectric and impregnating media.

23-209. **Light Alloy Sections for Shipbuilding.** W. Muckle. *Light Metals,* v. 9, July '46, p. 386-390.

Examination of fundamental principles governing most advantageous and economic replacement of rolled steel sections by appropriate special forms in aluminum.

23-210. **Metallurgical Development of Materials for Turbosuperchargers and Aircraft Gas Turbines. Part 1.** W. L. Badger. *Iron Age,* v. 158, July 25, '46, p. 40-45.

Metallurgical development of alloys suitable for the severe high temperature service requirements of aircraft turbosuperchargers, from S.A.E. 2335 and 6150 up to the present day Timken and Vitallium alloys, is described. Improvement in stress-rupture values of wheel material and bucket alloys over the past quarter century is graphically illustrated. Discusses some of the other metallurgical headaches which plagued the development of the supercharger.

23-211. **Modern Steels in Railroad Construction.** H. Malcolm Priest. *Welding Journal,* v. 25, July '46, p. 646-649.

History of railroad materials from 1846; change to heavier rails; low-alloy, high strength steels for cars; welded fabrication.

23-212. **Aluminum Pistons.** *Metal Industry,* v. 69, July 19, '46, p. 48-49.

Description of two German works producing aluminum alloy pistons. (From report of British Intelligence Objectives Subcommittee.)

23-213. **Metallurgical Development of Materials for Turbosuperchargers and Aircraft Gas Turbines. Part 2.** W. L. Badger. *Iron Age,* v. 158, Aug. 1, '46, p. 60-66.

Problems of grain size in cast buckets, mass effect of large forgings, effectiveness of inspection methods, center cracks in wheel forgings, conservation of alloys and distortion of magnesium parts.

23-214. **Revolution in Roofing.** *Sheet Metal Worker,* v. 37, July '46, p. 40-42.

Coper-Cel composite unit, its advantages and applications.

23-215. **Stainless Steel in the Petroleum Industry.** John S. Ewing. *Petroleum Engineer,* v. 17, July '46, p. 108-116.

Various steels used in the petroleum industry, with special emphasis on Stainless W.

23-216. **Bolt Failures.** L. Kasper. *Modern Machine Shop,* v. 19, Aug. '46, p. 182, 184, 186, 188, 190, 192, 194, 196, 198, 200.

Bolt failures may be reduced by designing the parts so as to maintain, within the restrictions imposed by the design, the smallest possible tensile and shear loads, by proper preparation of the contact surfaces and by proper tensioning to approach as closely as possible a condition of zero stress change ratio.

23-217. **Aluminum Roofing for Cincinnati's Union Terminal.** *Steel,* v. 119, Aug. 5, '46, p. 132, 149.

In replacing dome-shaped roof on the railway center, 1123 sections of preformed and precurved 14-gage aluminum sheets were required to cover its 32,000 sq.ft. Job completed in 3½ months.

23-218. **Manufacture of Surgical Instruments.** Floyd McKnight and Joseph G. Cowley. *Steel,* v. 119, Aug. 5, '46, p. 126-127, 170, 172, 174.

Stainless steel is basic material for production process; odd combination of hand craftsmanship and modern metalworking methods.

23-219. **Postwar Horizons for Aluminum.** F. Keller. *Mining and Metallurgy,* v. 27, Aug. '46, p. 431-433.

Some of the new aluminum alloys and their present and potential uses. One of the most important is aluminum hardened with zinc and magnesium. Also mentions aluminum welding, brazing, and resin bonding processes and the Alrok and Alumilite treatments for surface finishing of aluminum.

23-220. **From Aluminum Oxide to Rolled Aluminum Sheets.** *Machinery,* v. 52, Aug. '46, p. 176-179.

Illustrations show various steps in the manufacturing process, starting with the production of aluminum from aluminum oxide and ending with the rolling of the sheets.

23-221. **Aluminum Pallets Cut Material Handling Cost.** *Iron Age,* v. 158, Aug. 8, '46, p. 66-67.

Advantages of the unit load method of handling mate-

rials are pointed out, together with an indication of the savings in handling and shipping costs.

23-222. **A Signal Achievement.** *Die Casting,* v. 4, Aug. '46, p. 21, 48-51.

In a suspended-type traffic signal where weight saving is essential 25% of the weight has been saved by designing these units as die castings.

23-223. **Serving Time.** M. H. Rhodes. *Die Casting,* v. 4, Aug. '46, p. 26, 28, 30, 41-42.

Die cast undercut saves assembly time and costs in coin-operated meters. Smooth surface of castings simplifies application of organic or plated finishes.

23-224. **Tend to Your Knitting.** *Die Casting,* v. 4, Aug. '46, p. 33-34, 47-48.

Tompkins machines include some ingenious devices for controlling movement and tension of thread from spools to needles. Die castings perform significant functions and have, in most cases. replaced gray iron castings.

23-225. **Giant Axle Units for Terra Cobras.** W. A. Witham. *Western Machinery and Steel World,* v. 37, Aug. '46, p. 98-101.

With exception of the carrier casting and fabricated banjo housing, all stressed parts in the Pacific-Western axle are made of alloy steel drop forgings. Routine checks are made in the modern, well-equipped Western Gear metallurgical laboratories to control grain size, grain flow, chemical analysis, physical properties and hardenability before material is processed. Production procedures outlined.

23-226. **Steel Roofing Fabricator Switches to Aluminum.** *Modern Metals,* v. 2, Aug. '46, p. 10-11.

Conversion of a large prewar steel fabricator to aluminum, and some of the markets this company is servicing with aluminum prefabricated buildings, latrines, shingles and roofing.

23-227. **"Metalite" for Structural Uses.** *Aero Digest,* v. 53, Aug. '46, p. 82, 115.

Metalite consists of thin sheets of high strength aluminum alloy, separated by a thick, low density core of balsa wood, with the whole bonded firmly together to form a single, light, rigid unit. Grain direction of the balsa core is set perpendicular to the metal faces. Is constructed by bonding the core and faces together under moderate heat and pressure, all the bonds being ordinarily made in one operation.

23-228. **How to Insure Accuracy in Gear Manufacture.** Don Moncrieff. *Western Metals,* v. 4, Aug. '46, p. 32-33.

Control of tooth profile; tooth spacing; helical lead and spur gear tooth alignment; size and concentricity.

23-229. **Conversions to Stampings Reduce Costly Manufacturing Operations.** *Steel Processing,* v. 32, Aug. '46, p. 509-510, 524.

Examples illustrate a few of the many ways in which stampings are being substituted for machined castings. Complicated cast parts can frequently be redesigned as

an assembly of stampings with stampings or as an assembly of stampings and machined parts. Assemblies are made into a completed part by selecting the best joining method for the particular job—copper, hydrogen or silver brazing, electric or flame welding or mechanical means such as riveting.

23-230. **Phosphor Copper and Phosphor Bronzes as Used in the Manufacture of Wire and Strip.** C. P. Bernhoeft. *Wire Industry,* v. 13, Aug. '46, p. 445-448.

Some properties of phosphorus; the manufacture of 10% phosphor copper; some properties of phosphor copper; some properties of malleable phosphor bronzes; the manufacture of phosphor bronzes; a method for manufacture of phosphor bronze wire. 11 ref.

23-231. **Refining Noble Metals, Their Alloying and Fabrication.** *Metallurgia,* v. 34, July '46, p. 127-128.

Working of silver, gold and metals of the platinum group and their application to industry. Chemical plant and apparatus; instruments; electronics; switchgear; resistance welding; low-temperature brazing.

23-232. **Metallurgical Aspects of X-Ray Tube Manufacture. (Concluded.)** M. J. Zunick. *Instrument Maker,* v. 14, July-Aug. '46, p. 14-16, 18.

Materials and processes used in manufacture of anodes and cathodes and processes for making glass to metal seals and for exhausting X-ray tubes.

23-233. **DeHavilland Goblin. Part II.** J. A. Oates. *Aircraft Production,* v. 8, Aug. '46, p. 386-398.

Methods employed for the manufacture of the turbine blades; complete sequence of operations; machines and fixtures used. Procedure for assembling the turbine and stator blades, the machining operations on certain other components, and some of the test rigs installed in the build shop.

23-234. **Engine House Gets Aluminum Roof Trusses.** *Railway Age,* v. 121, Aug. 31, '46, p. 362-363.

Replaces former steel construction which had become seriously weakened by corrosion due to locomotive stack gases.

23-235. **Steels for Die-Casting Die Blocks.** James L. Erickson. *Materials & Methods,* v. 24, Aug. '46, p. 389-396.

Type of alloy cast and length of run make varying demands on steels for die-casting die blocks. Discusses carbon, alloy and toolsteels for lead, tin, zinc, aluminum, magnesium and copper-base alloys. Includes tables.

23-236. **High-Pressure Gasholders.** G. M. Gill. *Gas Journal,* Aug. 7, '46, p. 236-237, 240-241; Aug. 14, '46, p. 272, 275.

Advantages, operating and maintenance costs, pros and cons of welded and riveted construction, and spherical high-pressure holders; descriptions of several British installations.

23-237. **The Shortening of Eyebars to Equalize the Stress.** *American Railway Engineering Association, Bulletin 460,* v. 48, June-July '46, p. 1-18.

A method has been developed to shorten eyebars by heating with oxy-acetylene torches which takes less time and is more economical than any other method heretofore used.

23-238. **Production of Ignition Radio Shields.** F. T. Van Syckel. *Iron Age,* v. 158, Aug. 29, '46, p. 56-58.

Production of ignition radio shields for aircraft involves the extensive use of silver alloy brazing and special jigs, fixtures, and gages. Production procedures outlined are also applicable to similar units for automobile and marine shielding.

23-239. **Bethlehem Steel Modernizes Its Axle Manufacturing Facilities.** *Railway Age,* v. 121, Sept. 7, '46, p. 406-407.

New equipment includes a continuous rotary-hearth heating furnace, a number of gas-fired pits for control cooling of finished forgings, an axle straightener of novel design, and a number of minor auxiliaries.

23-240. **Electronic Equipment in Wire-Rope Manufacture.** P. Somerville, L. R. Hunt and J. C. Campbell. *Machinery (London),* v. 69, Aug. 15, '46, p. 201-205.

Disadvantages of group winding; gains effected by adding a Thy-mo-trol control.

23-241. **Cemented Carbides Make Die Materials.** Ben C. Brosheer. *American Machinist,* v. 90, Sept. 12, '46, p. 101-105.

Latest experience with the war-developed application of carbides to dies and punches in a number of plants.

23-242. **Die-Cast Ball Mounting Saves Production Time on New Type Bearing.** *Die Castings,* v. 4, Sept. '46, p. 35.

Ball mounting, now die cast, was originally produced from aluminum tube stock as a screw machine part which called for several machining operations and an assembly operation. Now units are die cast in zinc-base alloy and are produced in gates of four.

23-243. **Fill 'er Up.** Charles S. Hazard. *Die Castings,* v. 4, Sept. '46, p. 36-42, 44-45.

To gain competitive advantage in reduced manufacturing costs, while maintaining high functional standards, Neptune Meter Co. has turned to zinc-base die castings for measuring flow of petroleum products.

23-244. **Report of the Committee on Wheels.** *Railway Mechanical Engineer,* v. 120, Sept. '46, p. 473-475.

Modification in design of two chilled wheels to eliminate retarder interference; study of impact effect of flat spots on wheels and revisions in wheel practice.

23-245. **Zirconium for Electron Tubes.** George A. Espersen. *Foote Prints,* v. 18, '46, p. 3-7.

Some of the uses of zirconium in electronic tubes.

23-246. **Gas Turbines. Use of Steel Under High-Temperature Conditions.** C. Cyril Hall. *Iron and Steel,* v. 19, Aug. '46, p. 455-457.

Some of the metallurgical problems involved in the modern gas turbine are indicated and data given relating

to some of the steels which have made the gas turbine possible.

23-247. **Tin Plate in the Future.** *Iron and Steel,* v. 19, Aug. '46, p. 471-474.

Fundamental changes in manufacture; substitutes for tin; plastic closures vs. tin; defects of lacquer; tin undercoatings.

23-248. **Cast Iron. Its Use in Contemporary Building and Engineering.** J. G. Pearce. *Iron and Steel,* v. 19, Aug. '46, p. 475-479.

A brief survey of some of the less obvious uses of iron castings.

23-249. **Aluminum and Magnesium in the Electrical Industries.** B. J. Brajnikoff. *Light Metals,* v. 9, Aug. '46, p. 393-397.

Application of aluminum in high-voltage condensers with compressed gas insulation.

23-250. **Development of D.T.D. 424.** G. D. Chapman. *Light Metals,* v. 9, Aug. '46, p. 398-400.

Summarizes briefly the course of evolution of what is now a popular foundry alloy and describes early difficulties encountered in its practical introduction.

23-251. **Light Alloys in Rectifiers, Photocells and Condensers. (Continued.)** *Light Metals,* v. 9, Aug. '46, p. 408-413.

Aluminum and pigmented cellulose lacquers and enamels with special reference to corrosion resistance and durability tests.

23-252. **Small Craft in Light Alloy.** *Light Metals,* v. 9, Aug. '46, p. 414-420.

Boats of various types manufactured by the Heston Aircraft Co., Ltd., and the Warwick Aviation Co., Ltd., together with others constructed according to the specifications of, and in materials supplied by the Reynolds Tube Co., Ltd.

23-253. **Industrial Plant Features Variety in Radiant Panels.** *Heating and Ventilating,* v. 43, Sept. '46, p. 58-61.

Radiant heating system at the new Kankakee Works of the A. O. Smith Corp. This system, composed of wrought iron, copper and copper-clad steel tubing, is designed to circulate 15,000 gallons of water throughout the system 12 times per hr.

23-254. **Corrosion Resistant Metal Covered Rolls.** H. Ross Strohecker. *Paper Trade Journal,* v. 123, Sept. 12, '46, p. 54.

Method of manufacture of metal covered rolls; their application to the paper industry.

23-255. **Advances in the Chemistry of the Offset Printing Process.** Wm. H. Wood. *American Pressman,* v. 56, Sept. '46, p. 27, 30.

Some new developments including new plate metals and alloys, new counter etches, new sensitizing agents, new materials for making albumen-type plates, new colloids for deep-etch coatings, gum substitutes, improved drying oils for inks, new synthetic rubbers for blankets and high wet strength papers.

23-256. **An Old Hand With Aluminum.** Russel Wright. *Modern Metals,* v. 2, Sept. '46, p. 12-13.

Early experiences with aluminum as well as some potential markets for light metals.

23-257. **The Fabrication of Light Metals Products.** Robert J. Schneider. *Modern Metals,* v. 2, Sept. '46, p. 14-18.

Describes the many advantages possible through utilization of light metals.

23-258. **Aluminum for Selenium Rectifiers.** J. Loebenstein. *Modern Metals,* v. 2, Sept. '46, p. 23.

Use of selenium rectifiers for converting current is being extended into new and larger fields because of larger plate sizes and greater voltage-carrying capacity. Aluminum is used in Radio Receptor's rectifier as the base plate. Brief discussion of its advantages is given.

23-259. **German Mass Production Methods. The Use of Stamped Components in Gun Manufacture.** Charles E. Balleisen. *Army Ordnance,* v. 31, Sept-Oct. '46, p. 147-148.

A German report on the application of sheet-metal stampings in the manufacture of aircraft weapons.

23-260. **Forty Miles of Piping Used in New Plant's Radiant Heating System.** *Steel,* v. 119, Sept. 23, '46, p. 112-113, 178-179.

Combination grid and continuous coil construction of wrought iron pipe permits rearrangement of machines and even new foundations. Wrought iron, steel, and copper tubing, requiring almost 27,000 brazed and welded joints, will circulate 180,000 gal. of hot water per hr. to heat 415,188 sq.ft.

23-261. **Copper Hoods and Ducts Solve Hatter's Problem.** *Sheet Metal Worker,* v. 37, Sept. '46, p. 49, 84.

Designs of an exhaust system that successfully rids felt processing room of unbearable heat and steam.

23-262. **Use of Steel Marks Turning Point in Motor Design.** F. C. Rushing. *Steel,* v. 119, Sept. 30, '46, p. 94, 96-97, 99-100.

Steel substituted for cast iron in new alternating current motors results in a 35% smaller motor with starting torque increased 134% per lb. of motor.

23-263. **Magnetostriction in Industry Processes.** Frances Sloane. *Electronic Industries,* v. 5, Oct. '46, p. 74-76, 101.

Magnetostriction refers to the relations that exist between the magnetic state and the mechanical properties of magnetic materials. Several important effects of magnetostriction are summarized. Explains how magnetostriction is used in submarine signalling and suggests numerous other potential applications.

23-264. **Opening the Window on Hidden Economies.** *Die Castings,* v. 4, Oct. '46, p. 19-20, 40-41.

Detroit Hardware Mfg. Co. has, by careful redesign of several die-cast items, simplified fabrication and reduced costs. Zinc-base die castings used in a large number of their products.

23-265. **Cut Out for the Job.** H. J. Thiessen. *Die Castings,* v. 4, Oct. '46, p. 21, 50-51.

Pneumatic type hacksaw is comprised in the main of six zinc alloy die castings which make up the combination housing and mount for all the accessory components. Felt retainer and air connection are also die cast.

23-266. **The New Motorola Auto Heater.** *Die Castings,* v. 4, Oct. '46, p. 22-24, 42-43.

Temperature differentials have no important effect upon the aluminum alloy die casting which forms the most critical component of this new type heater. Distortion, leakage of burned gases, corrosion and misalignment have been avoided by using aluminum die castings.

23-267. **Pee-Wee Choo-Choo.** *Die Castings,* v. 4, Oct. '46, p. 33-34.

Fine detail is obtained by die casting the tiny parts for these model locomotives. Drive rods with holes cored on centers within 0.002 in. are made on miniature scale.

23-268. **A Pioneer in Low-Cost Quality Production.** Tom Loring. *Die Castings,* v. 4, Oct. '46, p. 36-40.

Since the first die-cast radiator grille was installed on the Oldsmobile in 1935, great advancement has been made in the design and production of die castings, with the result that current models employ a wide range of die-cast parts.

23-269. **A Simplified Assembly Line for a Complex Machine.** *Die Castings,* v. 4, Oct. '46, p. 56-58.

A combination of die castings and machine screws makes a speedy job of assembling Wurlitzer juke boxes. Some of the assembly techniques are discussed, showing how the production line brings the subassemblies into the mounting line.

23-270. **Aluminum Paint Vehicles and Their Effect on Leafing.** J. Wright. *Official Digest,* Sept. '46, p. 393-397.

Results of test made to determine those characteristics of the usual types of aluminum paint vehicles, which contribute to the proper leafing of paint grades of aluminum pigments, either powder or paste.

23-271. **Cable Sheathing in Aluminum.** *Light Metals,* v. 9, Sept. '46, p. 474-498.

Possibility of replacing lead by aluminum is examined critically in the light of economic and technical considerations arising from an exhaustive comparison of these two metals from the standpoints of their mechanical and physical properties and amenability to working. Lines of future development in large-scale production are suggested. (Based on accounts by Deisinger, *Z. fur Metallkunde,* v. 31, 1939, p. 305; Hanff, Hosse and Deisinger, *Siemens Zeit.,* v. 19, 1939, p. 357; Deisinger, *Metallwirtschaft,* v. 18, 1939, p. 963; and Czempiel and Haase, *Aluminum (Germany),* v. 21, 1939, p. 521.)

23-272. **Some Chemical and Physical Problems in the Manufacture of Selenium Rectifiers.** C. A. Escoffery. *Electrochemical Society Preprint* 90-6, '46, 21 p.

Various methods of manufacturing selenium rectifiers. Procedures for etching aluminum and steel baseplates to secure adhesion of the selenium layer. Phenomenon of

inhibition of etch with steel. Barrier layer treatments and electroforming; a hypothesis for the latter consisting in the cathodic reduction of selenium and migration of electronegative selenium ions to the counterelectrode under the applied potential.

23-273. **Copper and Its Alloys in Automobiles.** *Automotive and Aviation Industries,* v. 95, Oct. 1, '46, p. 31, 64.

Poundage in various 1946 cars; which parts are made of copper, brass, or bronze.

23-274. **Knock-Down All-Aluminum Bodies Developed by Reynolds for Trucks.** *Automotive and Aviation Industries,* v. 95, Oct. 1, '46, p. 44, 77.

Exploded view of the standard truck body, as illustrated, shows the basic scheme of design applicable to all body models. Fabrication and assembly of body sections.

23-275. **Steel Beer Barrels: A Study in Fabrication.** P. D. Aird. *Modern Industrial Press,* v. 8, Sept. '46, p. 13-14, 16, 44.

Heavy-gage steel is used. Precise presswork; ingenious welding and assembly; cleaning and finishing.

23-276. **Producing Corrosion Resistant Fishing Reels.** M. G. Hawkins. *Modern Industrial Press,* v. 8, Sept. '46, p. 20, 22.

Methods used at Ravenna Metal Products Co., Seattle, Wash. Blanking, piercing, cutting, inspection, assembly.

23-277. **Gas Turbines. (Concluded.)** C. Cyril Hall. *Iron and Steel,* v. 19, Sept. '46, p. 499-501, 505.

Use of steel under high-temperature conditions; duties various parts are required to fulfill in modern engines; processes used in making those parts and their properties over a range of temperatures.

23-278. **Magnesium Golf "Woods".** E. R. Coyle. *Modern Metals,* v. 2, Oct. '46, p. 18-19.

Advantages of magnesium for golf clubs; manufacturing details.

23-279. **Magnesium in the Canadian Chain Saw Industry.** J. E. Lindsay. *Modern Metals,* v. 2, Oct. '46, p. 22-24.

Canadian chain saw industry has turned to magnesium for light weight, strength, machinability, and increased sales appeal. Early German saws; material conversion; low-cost assemblies; excellent serviceability; corrosion resistance; quality.

23-280. **The Magnesium Copper Sulphide Rectifier.** R. O. Whitesell. *Modern Metals,* v. 2, Oct. '46, p. 24-26.

Assembly construction; cell sizes and ratings; cell construction and circuit operation.

23-281. **Magnesium for Electronic Air Filters.** Ben F. Taylor. *Modern Metals,* v. 2, Oct. '46, p. 31-32.

Theory of electronic air filtration and a description of the modern plate-type electronic air filter.

23-282. **Magnesium Castings Replace Gray Iron for Lubricator Reservoirs.** Oscar Blohm. *Modern Metals,* v. 2, Oct. '46, p. 49-50.

Comparative machining and casting costs of magnesium and cast iron for this product.

23-283. **Porcelain Enameled Steel in Architecture.** Carl F. Block. *Finish,* v. 3, Oct. '46, p. 19-23.
An outline of present uses and vision of what the future will bring.

23-284. **Modern Labels—They're Aluminum!** *Glass Packer,* v. 25, Oct. '46, p. 782-783.
Applications and advantages.

23-285. **Magnesium Engraving Plates More Economical.** *Modern Metals,* v. 2, Oct. '46, p. 32-33.
Experience of several users. Brief reference to economic advantages of magnesium.

23-286. **Portable Magnesium Tower.** Martin Ulmes. *Modern Metals,* v. 2, Oct. '46, p. 34.
Fifty-foot tower for use with two-way beamed radio telephone.

23-287. **Conveyers, Ladders, and Scaffolding.** G. H. Reppert. *Modern Metals,* v. 2, Oct. '46, p. 36-37.
Illustrates use of magnesium for scaffolding. Such applications have approximately half the strength of steel.

23-288. **Line Processing Tower.** A. J. Marotta. *Modern Metals,* v. 2, Oct. '46, p. 41-42.
Use and advantages of magnesium spools for winding fishline during process of impregnation.

23-289. **Piano Developments.** F. Kelso Davis. *Modern Metals,* v. 2, Oct. '46, p. 44-45.
New uses for magnesium in piano construction.

23-290. **Magnesium Canoe.** Ralph G. Gillespie. *Modern Metals,* v. 2, Oct. '46, p. 46-47.
Fabrication details.

23-291. **Abrasives—Technological Advances in an Essential Industry.** William H. Waggaman and Oliver C. Ralston. *Chemical and Engineering News,* v. 24, Oct. 10, '46, p. 2612-2615.
Natural abrasives; manufactured abrasives; advances in recovery, manufacture, and grading; synthetic products; sand blasting and selecting and handling. 14 ref.

23-292. **Portable X-Ray Unit Utilizes Magnesium.** William Kes. *Materials & Methods,* v. 24, Sept. '46, p. 626-627.
Use of magnesium for principal castings in a portable chest X-ray unit reduced its weight by 300 lb. over previous sheet metal model.

23-293. **Wire and Ribbon Form.** Herbert Chase. *Materials & Methods,* v. 24, Sept. '46, p. 628-632.
Materials used; production rates; design considerations in production of miscellaneous items.

23-294. **Aluminum Rotors for Electric Motors.** J. Piget. *Materials & Methods,* v. 24, Sept. '46, p. 698, 700.
Problems encountered in the substitution of aluminum for copper in the rotors of asynchronous motors are discussed and their solutions outlined. Aluminum compares very favorably with other metallic conductors. (Abstracted from *Revue de l'Aluminium,* v. 120, March '46, p. 89-93.)

23-295. **Wire Forms and Stampings Make Good Partners.** Herbert Chase. *Iron Age,* v. 158, Oct. 17, '46, p. 48-54.

Numerous examples of the profitable use of wire forms and stampings; technique and equipment used to form wire, ribbon, and other sectional shapes in wire forming machines.

23-296. **Developments in Aircraft Engine Metallurgy, 1920-46.** Walter E. Jominy. *Metal Progress,* v. 50, Oct. '46, p. 687-690.

Use of magnesium, silver, stainless steel, chromium plate, sintered bushings, forged aluminum and nitralloy. New processes discussed are grain size control, hardenability testing, and magnaflux testing.

23-297. **Aluminum in British Architectural Design.** James L. Erickson. *Light Metal Age,* v. 4, Sept. '46, p. 14-16, 30.

Forms in which aluminum is available and purposes for which it is utilized. Photographs illustrate how effectively British designers are employing aluminum and its alloys to achieve remarkably beautiful effects in the architectural design of commercial structures.

23-298. **Light Alloyings.** *Light Metal Age,* v. 4, Sept. '46, p. 18-19.

New uses and new markets for light metals.

23-299 **The Production of Aluminum Cooking Utensils.** *Machinery (London),* v. 69, Sept. 19, '46, p. 353-359.

The range of utensils includes frying pans, colanders, and a number of thick-bottomed saucepans for use particularly on electric hot plates. Describes stages in production of various items.

23-300. **The Production of Railway Wagon Wheels and Tires.** *Machinery (London),* v. 69, Sept. 26, '46, p. 385-393.

Methods of obtaining blocks to produce the wheels; furnaces for heating the blooms; five main stages in production of the wheels.

23-301. **Welding, Flame Cutting for Efficient Maintenance and Low Cost.** A. D. Stout, Jr. *Coal Age,* v. 51, Oct. '46, p. 97-100.

Modern welding and flame cutting equipment lends itself to repair, rebuilding and fabrication of mining equipment. How it can be employed in the maintenance of coal mining machinery.

23-302. **Developments in Aircraft Materials and Processes.** Paul E. Lamoureux. *Western Miner,* v. 19, Oct. '46, p. 50-56, 58, 60, 62, 64.

Data concerning aluminum alloys, alloy steels, superalloys for gas turbines, wood, plastics, adhesives, fuels, lubricants, and rubbers. Recent developments in shotpeening, corrosion protection, X-ray inspection, heat treatment, cold treatment, metal joining, and electroplating.

23-303. **The Manufacture of Steel for Basic Rope.** Ralph D. Hindson. *Wire and Wire Products,* v. 21, Oct. '46, p. 768-769, 772-774.

Manufacture of rope wire from the openhearth to the finished rod.

23-304. **Light Alloys in Rectifiers, Photocells and Condensers. (Continued.)** *Light Metals,* v. 9, Oct. '46, p. 517-524.

Finishing processes in the manufacture of fixed paper condensers are concluded with the methods of identification marking. Preliminary comments are made upon inspection systems and testing techniques prior to dispatch. (To be continued.)

23-305. **The Light-Metal Home.** *Light Metals,* v. 9, Oct. '46, p. 539-561.

Surveys the present position and suggests ideas for the future in the domestic use of light alloys. 11 ref.

23-306. **Belt Tensioning With Steel Cords.** Paul D. Suloff. *Steel,* v. 119, Oct. 28, '46, p. 72-75, 93, 96.

Use of small, strong steel wires in rubber tires leads to successful development of steel cable-embedded industrial drives and conveyer belting. Steel cords are embedded in a layer of rubber or synthetic compound designed to adhere to the brass plated cord, and to provide proper support for the cord under the radial forces on the pulleys.

23-307. **Repairing Contractors' and Steel Mill Equipment With Manganese Applicator Bars.** L. A. Davis. *Welding Journal,* v. 25, Oct. '46, p. 969-974.

Properties and applications of these bars, which are made in a large variety of shapes and sizes, for various repair jobs. They are made of either 13½% manganese steel or manganese-nickel steel for special applications.

23-308. **Metal Rectifier Developments—Possible Applications of Titanium Dioxide.** H. K. Henisch. *Electronic Engineering,* v. 18, Oct. '46, p. 313-314, 316.

Discusses desired improvements in dry plate rectifiers: operation at 100° C. without great loss of efficiency or life, and high-voltage low-current rectifiers of small size. Outlines work which has been done on selenium and germanium rectifiers. Explains how blue modification of TiO_2 can be produced and explains why this material should be suitable for rectifiers. Outlines problems which must be solved in order to produce TiO_2 rectifiers.

23-309. **Abrasion Resistant Alloy Reduces Milling Costs.** K. A. Delonge. *Engineering and Mining Journal,* v. 147, Oct. '46, p. 60-62.

Use of an alloyed nickel-chromium white cast iron known as Ni-Hard for ball and rod-mill liners and also for flotation cell and pump parts. Comparative data on service life of Ni-Hard and other commonly used alloys are cited to show superiority of the former.

23-310. **Recommended Application Methods for Aluminum Roofing.** J. S. Pollack. *Light Metal Age,* v. 4, Oct. '46, p. 22.

Explanation of the factors involved and detailed recommendations for applying corrugated and 5-V crimp alumium roofing and siding.

23-311. **Forgings for Stressed Fittings.** Waldemar Naujoks. *Aero Digest.* v. 53, Oct. '46, p. 82-83, 165.

The physical characteristics required for various forgings used in aircraft. Safety margins and maximum weight limitations combine to make the design of such forgings very difficult. Some of the factors which must be care-

fully controlled are: furnace temperatures and atmospheres, heating and cooling cycles, trimming, forming, and heat treating.

23-312. **Theory and Practice of Glass-Metal Seals. Part IV.** J. A. Monack. *Glass Industry,* v. 27, Nov. '46, p. 556-559, 576, 582-583.

Electrolysis in seals, a phenomenon which often results in tube failure because of leakage of current or cracking of the glass. Tabulates and discusses the commercially important glass-metal combinations and compares graphically the thermal expansion characteristics of these glasses and the alloys with which they may be used.

23-313. **Rubber-Metal Composites.** James A. Merrill. *Materials & Methods,* v. 24, Oct. '46, p. 891-895.

Characteristics of rubber-like materials; types of metals, alloys or other rigid materials that can be combined with them, methods of metal preparation, adhesive application, rubber preparation and vulcanization.

23-314. **Aluminum-Steel Trolley Wires.** L. Albert. *Materials & Methods,* v. 24, Oct. '46, p. 960, 964.

Aluminum supplies the high conductivity while the steel resists the wear. A composite wire of 0.062 sq. in. is equivalent to a 0.093-sq. in. section of copper. Experience with these aluminum steel wires has shown that they are very satisfactory on the whole, even though redesigning of the wire has been necessary in some cases. (Condensed from article in *Revue de l'Aluminium,* v. 23, no. 118, Jan. '46, p. 14-23.)

23-315. **New French Rapid Transit Car.** M. Victor. *Materials & Methods,* v. 24, Oct. '46, p. 970.

Triangular framework was steel, used in the form of welded shapes and covered with Plymax panels which had a wooden core sheathed on both sides with aluminum sheet. Most of the coach parts, fittings, and "copper work" were made of light alloys as were many of the auxiliary parts of the motors. A very important lightening of the equipment resulted from the use of stainless steel sheets in place of castings for the starting resistances, of aluminum for the wiring and of modifications of the electric and pneumatic equipment. (Condensed from *Revue de l'Aluminium,* v. 23, no. 121, April '46, p. 120-128.)

23-316. **Present Position of Magnesium in England.** A. H. Waterfield. *Aluminum and Magnesium,* v. 3, Oct. '46, p. 17, 45.

Air, naval and military applications; prospects in the general commercial field.

23-317. **Magnesium Industry's Progress in Reducing Costs.** J. D. Hanawalt. *Aluminum and Magnesium,* v. 3, Oct. '46, p. 18-19, 33, 35, 37.

History of magnesium; promising fields of development which will help to make magnesium articles cheaper and more useful in the future; service characteristics of magnesium which are unique and profitable to exploit.

23-318 **A New Approach in Designing High-Capacity Aircraft Brakes.** Byron H. Shinn. *Product Engineering,* v. 17, Nov. '46, p. 140-143.

Copper, its properties and suitability, versus ferrous metals, their properties and general characteristics when used as the friction surfaces of brakes.

23-319. **A Clean Case for Cost.** C. Vonk. *Die Castings,* v. 4, Nov. '46, p. 30-32, 34.

Factors in the design of a washing machine.

23-320. **Cost Reduction Factors in an Outboard Motor.** *Die Castings,* v. 4, Nov. '46, p. 36-41.

Comparison of schedules at Johnson Motors reveals not only fewer operations performed on die castings than on similar sand or permanent mold castings, but also simpler and faster operations. Detailed study of the use of die castings to reduce costs is presented.

23-321. **Applications of Fiberglas to Wire and Cable.** Fred F. Sampson, Jr. *Wire and Wire Products,* v. 21, Nov. '46, p. 885-888, 910-911.

Basic characteristics of fiberglas; recent developments; applications, particularly to wire and cable.

23-322. **Metal Thread Sealed Between Acetate Film.** *Modern Plastics,* v. 24, Nov. '46, p. 121.

Aluminum thread is sealed between two plies of specially formulated cellulose acetate film with the result that this new metallic thread is impervious to the moisture in the atmosphere. Cloth woven from these yarns can be washed and ironed within the heat limits normally prescribed for acetate fabrics.

23-323. **10,000 Welds Make a Trailer.** *Welding Engineer,* v. 31, Nov. '46, p. 48-51.

Fruehauf Trailer Co. turns out 20 completed stainless steel truck trailers in each shift by designing them for resistance welding. Each of these trailers requires an average of some 10,000 welds—made mostly with portable welding guns.

23-324. **Applications of Bessemer Bars Requiring Quality.** J. D. Armour. *Metal Progress,* v. 50, Nov. '46, p. 904-905.

Applications to bearings, surface hardened parts, gears, hubs for belt pulleys for refrigeration, washing machines, shot gun and rifle barrels, type for typewriters, and other parts.

23-325. **Power Costs Trimmed as Abrasion Takes a Licking.** *Inco,* v. 20, Fall '46, p. 4-6, 28.

Several applications of Ni-Hard alloy cast iron for grinding and pulverizing, and for parts subject to severe abrasive action.

23-326. **Armor Plate Steels Used in Huge Coal Stripping Dipper.** *Steel,* v. 119, Nov. 18, '46, p. 84-86.

Critical weight-capacity ratio factor is reduced from 4000 to 2100 lb. per yd. by use of low-alloy high-tensile steels. All-welded 40-cu.yd. dipper is of advanced design.

23-327. **Combined Operations Speed Output of All-Steel Motors.** F. C. Rushing. *Production Engineering & Management,* v. 18, Nov. '46, p. 59-61.

Some of the new methods used by Westinghouse at the Buffalo plant.

23-328. **Cost Cutting Methods Boost Output of the Whizzler.** *Production Engineering & Management,* v. 18, Nov. '46, p. 66-74.

Special innovations adopted in production of motorbike motors include controlled core making methods, multiple machine loading for finishing of precision-built units, and streamlined assembly operations.

23-329. **Aluminum Furniture.** G. W. Birdsall. *Modern Metals,* v. 2, Nov. '46, p. 14-15.

Manufacturing processes employed at Reynolds Louisville Plant 11.

23-330. **Gas Turbine Developments. No. II. Production of Aero Engine Combustion System Components.** *Engineer,* v. 182, Nov. 1, '46, p. 392-394.

Solutions of a number of production problems including press shops, machine shop, furnace equipment, and welded assemblies.

23-331. **Facts and Fallacies of Lead Exposure.** Felix Edgar Wormser. *Paint and Varnish Production Manager,* v. 26, Nov. '46, p. 291, 293-299.

Certain "fallacies" concerning the toxicity of lead and its compounds as encountered in diverse commercial products.

23-332. **Ferritic Disks for Gas Turbines.** D. A. Oliver and G. T. Harris. *Metallurgia,* v. 34, Oct. '46, p. 293-294.

Four brands of steel of ferritic type have been developed for gas turbines; their properties; manufacture of turbine disks from these steels.

23-333. **Recent Developments in Materials for Gas Turbines.** *Metallurgia,* v. 34, Oct. '46, p. 316-320.

Materials for turbine blades; turbine disks; turbine nozzle assembly; combustion chambers; compressors. (Summary of symposium presented before Institution of Mechanical Engineers.)

23-334. **Minerals and Chemical and Allied Industries. Part III. A Review of Sources, Uses and Specifications.** *Industrial Chemist,* v. 22, Oct. '46, p. 573-578.

In this series of articles detailed consideration is given to such minerals as can be used in those industries more or less in the form in which they can be produced by mining and dressing. This installment covers bentonite, beryllium, bismuth, bitumen, boric acid and borates, bromine, and cadmium. (To be continued.)

23-335. **American Research on Germanium.** William Bull. *Chemical Age, v.* 40, Nov. 2, '46, p. 531-533.

Work of Battelle Memorial Institute and Eagle-Picher Lead Co. in method of production on larger scale for important commercial uses. Film deposition methods; alloy systems.

23-336. **Alloy S-816—The Jet and Turbine Steel.** Thomas Y. Wilson. *Steel Processing,* v. 32, Nov. '46, p. 707-709, 723.

Chemical composition; structure; method of testing; heat treatment; fabrication; and applications.

23-337. **Modern Armor Plate.** H. R. Clauser. *Army Ordnance,* v. 31, Nov-Dec. '46, p. 252-253.
Techniques of production.

23-338. **I. C. Builds Aluminum Refrigerator.** *Railway Age,* v. 121, Nov. 23, '46, p. 875-879.
Design and construction of experimental refrigerator car built for Illinois Central.

23-339. **Welded Freight Car Construction.** R. L. Rex. *Welding Journal,* v. 25, Nov. '46, p. 1043-1048.
Results of survey of current trends in welded freight car construction.

23-340. **The Development of High-Strength Welding Quality Alloy Steels and Their Postwar Applications.** Howard Miller. *Welding Journal,* v. 25, Nov. '46, p. 1077-1079.
Wartime development of high-strength welding quality steel for gun carriages and subsequent application to end underframing of railroad passenger cars.

23-341. **Magnesium in Photo-Engraving.** H. E. Swayze. *Photo-Engravers Bulletin,* v. 36, Nov. '46, p. 53-63.
History and production; recovery from the sea; magnesium alloys; magnesium as an engraver's metal; characteristics of magnesium in photo-engraving.

23-342. **Directory of Materials for the Construction of Chemical Equipment.** *Chemical Engineering,* v. 53, Nov. '46, p. 110-119.
Nearly 600 items are arranged alphabetically within each of seven classes. Included are: manufacturer, essential nominal chemical composition, forms available, and primary uses.

23-343. **"Radiators"—an Interesting Example of Presswork.** P. D. Aird. *Modern Industrial Press,* v. 8, Nov. '46, p. 13-14, 16, 20, 26.
Parts produced for assembly are manufactured from four basic metals, lead, copper, brass and steel. Four types of radiators make up the bulk of the production. Describes and illustrates procedures and equipment.

23-344. **Aluminum Span for E-60 Railroad Bridge.** *Engineering News Record,* v. 137, Nov. 28, '46, p. 52-54.
What probably is the first all-aluminum span to carry railroad traffic has been installed as a deck plate girder in a bridge that has similar steel for comparison. Plates and shapes are high strength 14S-T alloy, while rivets, driven cold, are A17S-T.

23-345. **Stainless-Clad Stampings Enter the Automotive Industry.** *Steel Processing,* v. 32, Nov. '46, p. 710-711, 723.
In addition to the obvious advantages of much greater corrosion resistance of clad steel, cladding of 10 to 30% stainless commonly bonded to the mild steel backing insures greater resistance to chipping and to scars or scratches that would normally penetrate the usual chromium plating. Methods of production and some uses.

23-346. **Modern Hard Magnetic Materials.** K. Hoselitz. *Metal Treatment,* v. 13, Autumn '46, p. 213-222.
Development of efficient hard materials for permanent

magnets; their influence on magnet design; aging stability characteristics.

23-347. **Magnesium and Its Uses.** L. G. White. *Canadian Metals & Metallurgical Industries,* v. 9, Nov. '46, p. 33-34, 47.

Methods of prefabrication, corrosion resistant properties, surface treatments, cathodic protection, fire hazard.

23-348. **Stainless Steel Refrigerator Car.** Ray E. DeCamp. *Western Machinery and Steel World,* v. 37, Nov. '46, p. 88-91, 104.

Stainless steel, with its high resistance to corrosion, has been used for the sheathing of Consolidated Steel Corp.'s experimental general-purpose refrigerator car for the Santa Fe, together with stainless-clad ends. Details of construction and fabrication.

23-349. **Where to Use Low-Alloy, High-Strength Steels.** Harry S. Wharen. *American Machinist,* v. 90, Dec. 5, '46, p. 108-111.

High strength, easy fabrication, excellent corrosion resistance make them especially desirable for mobile equipment and other structures where weight and life affect operating and service costs.

23-350. **Very Thin Electrical Steel for High-Frequency Components.** G. H. Cole. *Electrical Manufacturing,* v. 38, Dec. '46, p. 104-107, 190, 192, 194, 196, 198, 200.

Silicon steel, cold rolled into strip of thicknesses as small as 1 mil, has been found to be an entirely practical material for magnetic cores in circuits operating at frequencies up to 2 megacycles.

23-351. **Aluminum and Magnesium in the Electrical Industries. (Continued.)** B. J. Brajnikoff. *Light Metals,* v. 9, Nov. '46, p. 609-618.

Some modern developments of high-voltage generation, with particular reference to the high electrical efficiency afforded by the use of aluminum in the construction of electrical generators. (To be continued.)

23-352. **Needle Production.** *Machinery (London),* v. 69, Nov. 21, '46, p. 651-656.

Separation and eye end grinding; scouring; plating; heading and inspection; hand heading.

23-353. **Nonferrous Alloy Materials for Mechanical Springs.** F. P. Zimmerli. *Product Engineering,* v. 17, Dec. '46, p. 85-87.

Physical and chemical properties of the commonly used nonferrous alloy spring materials are listed. Proper application and limitations of the materials under conditions requiring electrical conductivity, corrosion resistance, or resistance to loss of load at elevated temperatures.

23-354. **Fabricating Aluminum Radiators.** *Steel,* v. 119, Dec. 16, '46, p. 102.

Three novel machines developed by the Germans which may lead to manufacture of improved automobile and aircraft radiators.

23-355. **Some Observations on German Cable Manufacture.** R. A. Schatzel. *Wire and Wire Products,* v. 21, Dec. '46, p. 965-967, 980-985.

Observations made during recent inspection of German plants. Composite picture of the plant, the rod mill, the wiredrawing department. Manufacture of trolley wire; annealing; tinning; stranding; paper cable machines; drawing aluminum wire; magnet wire; impregnated paper cables; lead presses; rubber covering; insulating process; testing and repairs; taping; extrusion machines; braiding; mineral insulated cables.

23-356. **How to Select and Treat Mold Steels.** Ralph H. Hoensheid. *American Machinist,* v. 90, Dec. 19, '46, p. 130-132.

Hobbing materials; stainless steel molds; mold surface defects. Finish of plastics products will be only as good as the surface of the mold cavity. Defects from poor carburizing practice may offset steel selection and efficient polishing procedure. Materials are pure iron, alloy iron, toolsteels, and stainless steels, with some nonferrous alloys. Polishing and heat treating procedures given.

23-357. **1,500,000,000 Needles.** *Machinery (London),* v. 69, Nov. 14, '46, p. 615-624.

Processes of wiredrawing; cutting to length; pointing; skimming; stamping and eyeing; stamping tools.

23-358. **Steel for Enameling.** *Steel,* v. 119, Dec. 23, '46, p. 80.

Possibilities in substitution of mild steel for enameling stock during steel shortage. Lists items and types which should not be substituted, and recommends special procedures to be followed with the mild steel stock.

SECTION XXIV

DESIGN

24-1. **Do's and Don'ts in Die Casting Design. Part 3.** *Die Casting,* v. 3, Dec. '45, pp. 57-59.

Tips on design of die castings; flash location.

24-2. **Glass-to-Metal Seal Design.** W. J. Scott. *Electronic Engineering,* v. 17, Nov. '45, pp. 764-767.

Relative thermal contraction of glass and metal; basic glass-metal constructional elements; direction of principal stresses in the glass; stress along the glass-air surface, nigh and normal to the glass-air-metal junction; crack systems for rod seals loaded mechanically; rod seal of molybdenum through C.14 glass; rod seal of tungsten into glass into fused silica; rod seal of copper, "Dumet", nickel through C.12 glass.

24-3. **Design Considerations for Welded Machinery Parts.** George L. Snyder. *Steel Processing,* v. 31. Dec. '45, pp. 763-769, 776.

Discussion limited to dynamically loaded weldment machinery parts. Components of structures; in sections.

24-4. **Forging Die Design.** John Mueller. *Steel Processing,* v. 31, Dec. '45, pp. 774-776.

Illustrates and discusses forging die design for forging motor crankshaft.

24-5. **The Use of the Diamond Pin in Locating Work.** Burton R. Garrett. *Tool Engineer,* v. 15, Dec. '45, pp. 32-34.

Accuracy of location is enhanced by elimination of dimensional variations.

24-6. **Checking of Parts Requiring Compound Angles.** H. L. H. *Machinery (London),* v. 67, Nov. 29, '45, pp. 601-607.

Method of computing, dimensioning, and checking compound angles is based on two elements: clear, understandable drawing with auxiliary views that show all necessary information about the compound angles involved; a master part which is used for making a fixture, die, or jig to facilitate accurate machining of the required parts during production, and checking location and size of compound angles in inspection of these parts.

24-7. **The Technological Principles of Casting Design.** Victor M. Shestopal. *Foundry Trade Journal,* v. 77, Dec. 13, '45, pp. 317-322.

Discusses general design of castings. Tables give maximum permissible deviations in the dimensions and weight of gray iron castings, cast steel, malleable iron castings, copper alloy castings.

24-8. **Designing of "Trouble-Free" Dies, Part 52: Hot Forming and Straightening Dies.** C. W. Hinman. *Modern Industrial Press,* v. 7, Dec. '45, pp. 26, 28.

Types of forging die steels; arc-welded hydraulic presses; hot forming and straightening.

24-9. **Application of Gaskets and Cylinder Head Packings.** H. C. Matheis. *Modern Industrial Press,* v. 7, Dec. '45, pp. 34, 36.

Design considerations.

24-10. **Method of Checking Compound Angles.** James Ahearn. *Machinery,* v. 52, Dec. '45, pp. 182-185.

Method has advantage of not requiring any master blocks or parts.

24-11. **Design of Tools and Fixtures.** *Machinery,* v. 52, Dec. '45, pp. 191-194.

Die for forming extruded rivet in sheet-metal plate; instrument for checking bore diameters in long cylinders; spring-actuated receding guides for locating work in coining die; simple gage for checking pump gears.

24-12. **Design of Exhaust Systems, Part XVII.** F. H. Stebbins. *Sheet Metal Worker,* v. 36, Dec. '45, pp. 48-52.

Details of dust separators and arresters with tables of dimensions of various types.

24-13. **Considerations in Design of Weldments.** George L. Snyder. *Machine Design,* v. 18, Jan. '46, pp. 135-142.

Discusses limitations in processing weldments due to limitation of equipment and methods used in their production; discussion is limited to dynamically loaded welded parts.

24-14. **Designing and Using Milling Cutters and Fixtures, III.** C. W. Hinman. *Modern Machine Shop,* v. 18, Dec. '45, pp. 164, 166-168, 170, 172, 174, 176, 178, 180, 182, 184, 186.

Methods of procedure for designing milling fixtures and accessories.

24-15. **Die Castings in the Design of a Power Lawn Mower.** E. L. Boyce. *Die Casting,* v. 4, Jan. '46, pp. 18-22, 48-52.

Functionally designed to the characteristics of die castings; interchangeability of parts; simplified field servicing; desirable bearing qualities; tinkerproof construction; ease of assembly; reduced weight; reduced machining.

24-16. **What the Designer Should Know About Welded Machinery Parts.** George L. Snyder. *Machinery,* v. 52, Jan. '46, pp. 157-160.

Few basic considerations to aid the engineer in planning designs of machines and structures suitable for construction by welding. (Abstract of paper for American Society of Mechanical Engineers.)

24-17. **Standardization of Electrical Equipment for Machine Tools.** R. H. Clark. *Machinery,* v. 52, Jan. '46, pp. 176-178.

Requirements concerning wiring diagrams; standardized controls; some points of difference from the automotive standard; requirements pertaining to motors; wiring requirements; conduit and raceways; provisions specified for grounding. (Abstract of paper for American Society of Mechanical Engineers.)

24-18. **Design of Tools and Fixtures.** *Machinery,* v. 52, Jan. '46, pp. 185-188.

Die for forming irregular-shaped spring; riveting fixture for grooved stud; milling T-slots with carbide-tipped cutters; jig designed for drilling a bellcrank lever having a forked arm; die for punching holes in short tubes.

24-19. **Domestic Holloware of Novel Design.** *Light Metals,* v. 9, Jan. '46, p. 7-8.

Method of approach toward, and the evolution of, a design for saucepans and other domestic ware in light alloys to suit modern taste and circumstances.

24-20. **The Application of Fabricated Construction to Machine Design.** F. Koenigsberger. *Institution of Mechanical Engineers,* v. 152, Dec. '45, p. 245-261. Discussion, p. 262-274.

In machine structures, stiffness against distortion and freedom from vibrations are usually of major importance as compared with strength. A comparison of strength, stiffness, and freedom from resonance for simple fabricated steel and cast iron structures is given in the form of graphs. The problem of the design of ribs for static and shock load conditions and some design criteria. Observations on the procedure of stress relieving after fabrication. 11 ref.

24-21. **Pattern and Allied Equipment—Design, Redesign and Interchangeability.** William E. Tharp. *American Foundryman,* v. 9, Jan. '46, p. 30-37.

Designing engineers are weighing the advantages and disadvantages of foundry products as compared with the products of competitive processes. Lower cost per unit is the foundry's greatest asset. Close cooperation between the casting designer and the foundryman, to obtain greater casting accuracy and lower costs through correctly designed patterns and the use of interchangeable pattern and other equipment, is a factor for the foundryman's careful consideration.

24-22. **Structural Model Testing.** O. W. Loudenslager. *S.A.E. Journal,* v. 54, Jan. '46, p. 18-25.

Three model members of designs which can represent a number of prototype properties are described, as well as the use of each of these members, and the determination of bending, torsional, tensile, and compressive stresses by means of simple equipment. Design formulas are set forth for a member which represents the axial, torsional, and bending (in two planes) properties.

24-23. **Strain Hardening Under Combined Stresses.** W. Prager. *Journal of Applied Physics,* v. 16, Dec. '45, p. 837-840.

Experimental investigations of strain hardening of metals under combined stresses are usually conducted so that directions of principal stresses as well as ratios of their magnitudes remain constant during any one test. Paper

is concerned with incompressible isotropic materials which are stressed in this manner and deform in accordance with certain postulates. The most general stress-strain relation which can arise under these circumstances is established, and some special cases of this relation are discussed.

24-24. **Designing of "Trouble-Free" Dies, Part LIII.** *Modern Industrial Press,* v. 8, Jan. '46, p. 30, 32.

Forging steel parts in hydraulic presses.

24-25. **Some Observations on the Design of Forged Parts.** Waldemar Naujoks. *Steel Processing,* v. 32, Jan. '46, p. 31-34, 42.

Drop forging design; forging machine design; design of press forgings; flow lines.

24-26. **Do's and Don'ts in Gage Design.** Louis De L. Berg. *American Machinist,* v. 90, Feb. 14, '46, p. 129-132.

Several features that should not be overlooked when designing a gage are: Ease of inserting and removing the work, and repair or alteration of moving and gaging surfaces; rapidity of use; ease and accuracy of determining results; operator fatigue; and lastly, inspection by the gage checker with minimum effort before the gage is put into use.

24-27. **Designing Welded Machinery Parts.** George L. Snyder. *Steel,* v. 118, Feb. 4, '46, p. 124-127, 162, 164.

Basic considerations of design in developing dynamically loaded welded machine parts discussed from the standpoint of efficiently utilizing space and weight. When observed collectively, necessary understanding of the true relationship between single elementary factors is gained.

24-28. **Design Considerations for Machinery Parts.** George L. Snyder. *Industry and Welding,* v. 19, Jan. '46, p. 36-41, 66-67, 69-70.

Basic considerations for designer in developing weldments.

24-29. **Design Considerations for Welded Machinery Parts, Part II.** George L. Snyder. *Steel Processing,* v. 32, Jan. '46, p. 49-51, 57-58.

Conditioning and inspection methods; weight control, rigidity, size limitation; use of alloys.

24-30. **Welded Redesign Brings Marked Improvements to Electric Meat Saw Machine.** J. S. McKeighan. *Welding Journal,* v. 25, Jan. '46, p. 53-54, 56.

Former unit of cast design weighs 550 lb., as compared to the all-welded machine weighing only 350 lb. Incorporates significant features which increased over-all rigidity and strength and eliminated a time-consuming tension adjustment.

24-31. **Designing a Press Tool for Panel Production.** *Sheet Metal Industries,* v. 23, Jan. '46, p. 131-134.

Press capacity; panel design; tool design; operation layout; the blank; draw die; restrike and emboss die; trim and pierce die; flanging die.

24-32. **Designing Welded Machinery Parts. Part 2.** George L. Snyder. *Steel,* v. 118, Feb. 11, '46, p. 98-100, 102, 155.

Such factors of fabrication as freedom of design, weld quality, and economy made possible by careful positioning of welded joints.

24-33. What the Designer Should Know About Welded Machinery Parts. George L. Snyder. *Machinery,* v. 52, Feb. '46, p. 167-171.

Few basic considerations to aid the engineer in planning designs of machines and structures suitable for construction by welding. (Abstract of a paper for American Society of Mechanical Engineers.)

24-34. Good Die Set Design Reduces Product Cost. Charles R. Cory. *Production Engineering and Management,* v. 17, Feb. '46, p. 70-75.

Master die designer defines the principles governing the design of dies for pressworking metals and presents factors essential to the correct selection of optional types of flanging dies. Applications of air-operated stools and spring-loaded pressure pads are described.

24-35. Designing and Using Milling Cutters and Fixtures, V. C. W. Hinman. *Modern Machine Shop,* v. 18, Feb. '46, p. 168, 170, 172, 174, 176, 178, 180, 182.

Double-action equalizer; centralizing work; designing efficient clamps.

24-36. Aluminium Structural Sections. Henry Vita. *Metal Industry,* v. 68, Feb. 1, '46, p. 94.

Designer must consider the question from two points of view—a consideration of stresses involved, and the method of producing the part required. Lightness and non-corrosion factors govern use of the more expensive alloy where stresses play an important role and lightness is still required. The choice of the alloy considered in relation to the method of production.

24-37. Designing Welded Machinery Parts. Part 3. George L. Snyder. *Steel,* v. 118, Feb. 18, '46, p. 100-102, 140, 142, 143.

Specifications, weight control, rigidity and size limitations.

24-38. Magnesium Die Castings. Part I. General Design. Ralph M. Heintz. *Machine Design,* v. 18, Feb. '46, p. 101-104, 180.

Designer will achieve the most satisfactory results with magnesium die castings if he will: *(a)* "Let the die do the work" by incorporating in the casting every hole, relief, slit, slot, boss, insert, fin, insignia, lettering and decoration; *(b)* consult the die maker and die caster early and often; *(c)* provide for the removal of the smallest practical amount of material at machined surfaces; *(d)* keep the wall sections as thin as practicable in keeping with strength requirements, and strive for uniformity of section; *(e)* use generous fillets and avoid sharp corners inside or out; *(f)* select the most suitable corrosion-inhibiting treatment and if possible make it part of the shop routine procedure *(g)* don't ask properties of magnesium that it does not and cannot possess.

24-39. Design of Supersensitive Balancing Equipment. Karl F. Frank. *Machine Design,* v. 18, Feb. '46, p. 109-114, 180, 182.

Important design considerations; choice of vibration pickup, rotor suspension, system of indicating unbalance position, filtering the vibration signal, means for driving the rotor, and unbalance removal equipment that will not require any computation on the part of the operator. Machine must also be adaptable to the various manufacturers' types and sizes of rotors.

24-40. **Photoelasticity Solves a Knotty Snap-Ring Problem.** R. E. Orton. *Machine Design,* v. 18, Feb. '46, p. 115-116.

Snap ring used to retain a shaft on the strapping tool shown; original design of the retainer for this shaft consisted of a stamped plate held by cap screws to the base member. Redesign of this base member from a casting to a weldment made desirable the elimination of that part of the base to which the retainer plate was fastened.

24-41. **Brazed Stampings Reduce Engine Weight.** Paul Klotsch. *Machine Design,* v. 18, Feb. '46, p. 123-125.

Built largely from brazed sheet metal stampings instead of heavy forgings and castings, engine weighs only 58 lb. bare but produces up to 26 hp. Its cost is a small fraction of that of a standard engine.

24-42. **Elements of Welded Design. Part II.** George L. Snyder. *Welding Engineer,* v. 31, Feb. '46, p. 47-51, 60.

Treatment of intersections; warpage; when to stress relieve; dynamic vs. static loading.

24-43. **Electrical Robot in Laboratory Model Measures Stress in Piping Systems.** Lale C. Andrews. *National Petroleum News,* v. 38, Feb. 6, '46, p. R-108, R-110, R-112.

Describes how stresses can be accurately measured in a small-scale model, and then converted to the full-scale values which will be encountered in actual operation. A new type of electrical measuring head is employed, of sufficient sensitivity to detect deflections of the order of a millionth of an inch. An example of the calculations involved is given.

24-44. **Design and Tooling Aspects of the Ryan Fireball Fighter.** Ben T. Salmon. *Automotive and Aviation Industries,* v. 94, Feb. 15, '46, p. 24-27, 100, 102.

Constructed of high strength, post-aged aluminum alloy; dimpling solved by a hot dimpling process and a specially designed dimpling tool. Landing gear wheels made of die-cast, heat treated magnesium. All of the skin aft of the hinge line on the flaps, ailerons and rudder is of magnesium as are cable control quadrant and most of the miscellaneous pulley brackets and fittings.

24-45. **Basic Relationship of Hypoid Gears. Part II.** Ernest Wildhaber. *American Machinist,* v. 90, Feb. 28, '46, p. 131-134.

Shows why unequal pressure angles produce balanced tooth action and indicates required angles.

24-46. **Designing, Drafting, and Using Press Tools.** C. W. Hinman. *Steel Processing,* v. 32, Feb. '46, p. 110-115.

Determining the data for a blanking die; laying out the scrap strip; calculating the scrap strip; designing the die block; designing the punch; the completed press tool; operation of the automatic stop.

24-47. **Forging Die Design.** John Mueller. *Steel Processing,* v. 32, Feb. '46, p. 116-118.

"Upright helve hammer" presents many opportunities to combine hammer, upsetter, and forge roll operations to produce certain parts in a series of operations, by which abnormally high forging and machining costs can be avoided. Upright helve hammer as applied to the manufacture of gear shift levers, is the process of fullering, roughing, rolling, and planishing, for preparatory and subsequent finishing operations.

24-48. **Designing of "Trouble-Free" Dies. Part LIV.** *Modern Industrial Press,* v. 8, Feb. '46, p. 18, 26.

Die engineering and drafting technique.

24-49. **Design Considerations for Welded Machinery Parts.** George L. Snyder. *Metallurgia,* v. 33, Feb. '46, p. 183-188.

Some basic considerations for the designer in developing weldments; limitations in processing weldments; scope and limitation of equipment and methods used in their production; limited to dynamically-loaded welded machinery parts. (Presented at the Annual Meeting of American Society of Mechanical Engineers.)

24-50. **Simplified Broaching Set-Ups.** *Western Metals,* v. 4, Feb. '46, p. 43.

Example of how automatic broaching set-ups using relatively simple broaches can be designed to broach complex parts and effect substantial savings in production costs.

24-51. **A Survey of Phototemplate Methods.** Faurest Davis. *Journal of the Society of Motion Picture Engineers,* v. 46, Feb. '46, p. 134-156.

Survey covers phototemplate methods now in use in the Southern California airframe industry. Methods are concerned with the photographic reproduction of original engineering line drawings. Working details on procedures are given.

24-52. **Brittle Failure of Hogged-Out Fittings From 14 S-T Billets.** Given Brewer and Herman C. Ihsen. *Metal Progress,* v. 49, March '46, p. 566-571.

Stress analysis by "hole" coupon is a good criterion for detection of notch sensitive properties found in some 14 S-T billets, when the coupon is cut transversely and tested in tension in the ordinary way; billets for making large hogged-out fittings should be upset and drawn out at forging temperature before being machined, this procedure yielding a material possessing better ductility and less sensitivity to stress raising discontinuities.

24-53. **Allowable Working Stresses for Steels.** C. Lipson and G. Noll. *Product Engineering,* v. 17, March '46, p. 205-208.

Maximum allowable working stresses for different service conditions and four classifications of surface finish are given by charts for steels ranging from Brinell 160 to 555. To facilitate proper use of charts, concepts of strength in the light of new knowledge of properties of materials and of stresses are clarified. Factor of safety has been rationalized and a new concept of design factor evolved.

24-54. **Design Considerations for Welded Machinery Parts.** George L. Snyder. *Welding Journal,* v. 25, Feb. '46, p. 105-119.

Limitations in processing weldments; scope and limitation of equipment and methods used in their production.

24-55. **Aluminum and Its Alloys.** E. G. West. *Aluminum and the Non-Ferrous Review,* v. 10, Oct.-Dec. '45, p. 59-60, 62, 64-66.

An engineering approach, including mechanical properties, allowable stresses, deflections. A designer's approach indicating ways of working and manufacturing the material to five desired results.

24-56. **Magnesium Die Castings, Part II—Design Kinks.** Ralph M. Heintz. *Machine Design,* v. 18, March '46, p. 111-115.

Various short-cuts and "tricks" can be developed to improve die-cast parts as well as to decrease costs.

24-57. **Computation of Pulling Force and Stress Distribution in the Drawing of Wires.** T. Poeschi. *Engineers' Digest (American Edition),* v. 3, Feb. '46, p. 68-71.

Discussion and formulas for use in calculation of forces and stresses in wire drawing. (Abstract from *Metallwirtschaft,* v. 23, '44, p. 245-249.

24-58. **Engine Reliability Enhanced by "Stresscoat" Analysis. Part II.** Chester S. Ricker. *Aviation,* v. 45, March '46, p. 86-88.

Picture-story details are presented of this test method's application to crankshafts, as well as its utility in redesign of mainbearing cap, supercharger housing, and camshaft housing.

24-59. **Closer Tolerance Stock Size or Added Machining Operation.** Arthur Ainsworth. *Screw Machine Engineering,* v. 7, March '46, p. 56-59.

Discussion and sketches of six differently dimensioned parts and the application of the tooling for each part; design and sequence of operations when using material purchased to size; design and sequence of operations when using fractional-size material.

24-60. **Forging Die Design.** John Mueller. *Steel Processing,* v. 32, March '46, p. 174-177.

Cold trimmers.

24-61. **Simplified Design Slashes Plane Production Costs.** Alfred Marchev and Alfred Z. Boyajian. *American Machinist,* v. 90, March 28, '46, p. 99-102.

Simplified design of airframe structure reduced both fabrication time and tooling expense. Number of parts was cut three quarters; fabrication time 92%; cost from $1,750,000 to $400,000. Four design rules given.

24-62. **Designing of "Trouble-Free" Dies. Part LV.** C. W. Hinman. *Modern Industrial Press,* v. 8, March '46, p. 18, 20.

Low-cost punch equipment.

24-63. **The Theory of Plasticity—an Outline of Work Done in Russia.** W. W. Sokolovsky. *Journal of Applied Mechanics,* v. 13, March '46, p. A1-A10.

Plastic stress-strain relations; theory of viscous bodies;

stability questions; theory of elastic-plastic bending of plates and shells; theory of plastic state of plane strain. (Summary of address for Institute of Theoretical Mechanics in Moscow.) 24 ref.

24-64. **Design of Crankpins for Locomotives.** O. J. Horger and W. I. Cantley. *Journal of Applied Mechanics,* v. 13, March '46, p. A17-A33.

Results of a fatigue investigation made on full-size 9½-in. diameter crankpins by the Association of American Railroads. Fifty full-size crankpin-and-wheel assemblies were tested, using four different types of pins. All pins were of plain-carbon steel, normalized and tempered, having a carbon content of 0.52% and manganese of 0.80%. Large double-ended cantilever-type fatigue machines subjected the crankpin-and-wheel assemblies to rotating-bending stresses.

24-65. **Stresses in Rotating Disks at High Temperatures.** A. Stanley Thompson. *Journal of Applied Mechanics,* v. 13, March '46, p. A45-A52.

Method by which the problem of the rotating disk with any arbitrary profile can be solved, including the effect of plastic flow and of variable temperature, and including the change with temperature of modulus of elasticity, coefficient of thermal expansion, and allowable stress.

24-66. **Nonlinear Theory of Elasticity With Small Deformations.** E. Sternberg. *Journal of Applied Mechanics,* v. 13, March '46, p. A53-A60.

Applications to uniaxial tension and compression as well as torsion of right circular cylinders. Results obtained indicate second-order effects which were previously unnoticed because of the early linearization of the extended stress-strain relations.

24-67. **Designing Passenger Cars and Airplanes.** E. J. W. Ragsdale. *Railway Age,* v. 120, March 16, '46, p. 542-544.

Theory of design for the layman. The Budd machine for testing complete car structures.

24-68. **Internal Stress and the Fracture of Metals.** J. Selwyn Caswell. *Metallurgia,* v. 33, March '46, p. 236-242.

Some aspects of the relation between internal stress and the fracture of metals; suggests how the risk of failure may be diminished or avoided. Examples of good and bad design with explanatory notes.

24-69. **Fabrication of Porcelain-Enameled Parts—I and II.** *American Machinist,* v. 90, April 11, '46, p. 149, 151.

Metal thickness; flange design; welding; drawing; shearing the blanks.

24-70. **Controlled Low-Temperature Stress Relieving.** T. W. Greene and A. A. Holzbaur. *Welding Journal,* v. 25, March '46, p. 171s-185s.

Process offers an effective and practical method of eliminating residual stresses entirely or reducing them to negligible values without distortion or deformation. Experience has shown that this stress-relieving operation can be performed quickly, efficiently and economically on large welded structures.

24-71. **Welded Jig Design.** L. Astin. *Welder,* v. 14, Jan-Dec. '45, p. 8.

Advantages of welded fabricated steel-plate jig.

24-72. **Strain Analysis Quickly Finds Formability Limits. Part I.** George Gerard. *Aviation,* v. 45, April '46, p. 73-75.

How basic elongation data can be used in conjunction with a geometrical analysis to expedite the prediction of formability limits of a part.

24-73. **Design of Magnesium Castings for High Properties and Soundness.** C. J. McDowall. *Product Engineering,* v. 17, April '46, p. 340-343.

Proportions, properties and basic factors that must be considered to assure desired strength and stiffness and sound castings.

24-74. **Design and Fabrication of Welded Steel Reduction Gear Drive.** George L. Snyder. *Industry and Welding,* v. 19, April '46, p. 36-38, 80-84.

In large weldments, positioning and stress-relieving are essential considerations of the fabricator.

24-75. **Stress Analysis Methods.** W. M. Murray. *Materials & Methods,* v. 23, April '46, p. 1002-1006.

Use of stress analysis in the early stages of product design will often result in a reduction in material and processing costs and in better parts.

24-76. **Tolerances and Gage Design as Related to Product Design.** Irving D. Press. *Tool & Die Journal,* v. 12, April '46, p. 80-83, 93-95, 105.

Factors involved in the gaging of fastener holes and in assigning tolerances to the hole dimensions. Certain basic rules and procedures which will help insure interchangeability and economy in manufacture.

24-77. **Designing of "Trouble-Free" Dies. Part LVI. Multiple Blanking Dies.** C. W. Hinman. *Modern Industrial Press,* v. 8, April '46, p. 16, 47.

Design of a three-station piercing and blanking punch and die for cutting three blanks at each press stroke. The blank, a steel link, is shown, and a section of the scrap strip is seen above the blank.

24-78. **Forging Die Design.** John Mueller. *Steel Processing,* v. 32, April '46, p. 244-248.

Hot trimmers.

24-79. **Practical Considerations That Affect Gear Durability in Speed Reducers.** Kenneth N. Mills. *Product Engineering,* v. 17, May '46, p. 358-361.

Principles and practices underlying the design of gears for speed reducers, including a discussion of the factors that influence gear life. Practical methods of evaluating these factors in design use. Typical failures of gears.

24-80. **Materials and Manufacturing Processes Determine Economical Tolerances.** A. L. Klein. *Product Engineering,* v. 17, May '46, p. 374-376.

Compilation of reasons why unnecessarily small tolerances should not be specified on engineering drawings. This material is presented from the economic, manufac-

turing, and assembly standpoint and furnishes the design engineer with concrete examples of what and what not to avoid.

24-81. **Dual Dimensioning of Drawings for Machining and Casting Uses.** G. N. Cole. *Product Engineering,* v. 17, May '46, p. 398-400.

Comparison of two general methods of dimensioning parts on drawings. Detailed description of the system in which three classes of drawing dimensions are identified. Casting tolerances and tolerances on concentricity as a guide to the designer.

24-82. **How the Designer Can Tie-In With Statistical Quality Control.** W. H. Bloodworth. *Electrical Manufacturing,* v. 37, May '46, p. 102-105, 202-206.

Coordination between shop and engineering department is essential once statistical quality control is adopted, particularly in setting tolerances. System can also be used in evaluating laboratory test data on preproduction models.

24-83. **Utilizing Mechanical Properties in Die-Casting Design.** Joseph Marin. *Die Casting,* v. 4, May '46, p. 21-22, 47-51.

Analyzes stressed members with a view to weight reduction and elimination of structural failure.

24-84. **Rack Designs for Spindle Sleeves.** H. F. Williams. *Machine Tool Blue Book,* v. 42, May '46, p. 236-239.

Several designs of equipment for providing spindle movement.

24-85. **Industrial Applications of X-Ray Stress Analysis.** Don M. McCutcheon. *Industrial Radiography,* v. 4, Spring '46, p. 9-16.

A qualitative analysis of surface stresses in metals can be made by a number of rather simple X-ray diffraction methods. Examples of both qualitative and quantitative stress analysis in metals. Difficulties in applying the X-ray diffraction method to heat treated steel. Development of the Geiger counter or electron multiplier tube offers considerable promise in speeding up the process. Certain severe handicaps must be overcome before this method can compete with other methods of stress analysis.

24-86. **Comments and Observations on Experimental X-Ray Diffraction Stress Methods and Technique for Sand-Cast Magnesium Alloy Structures.** Frank D. Klein. *Industrial Radiography,* v. 4, Spring '46, p. 41-47.

Amplifies part of George L. Clark's paper in which he refers to intensive effort carried out in his laboratory on evaluation of strain in cast magnesium alloy.

24-87. **Apprentice Cam and Tool Design Series, Part II.** *Screw Machine Engineering,* v. 7, May '46, p. 45-47.

Principles of cam design: cross slide knurling in combination with a box tool operation from the turret; top knurling used in conjunction with a combination form and cutoff tool and cross slide knurling.

24-88. **Buckling of a Flanged Plate.** Henry L. Langhaar. *Journal of the Aeronautical Sciences,* v. 13, April '46, p. 187-191.

Investigation treats the buckling of an axially compressed isotropic elastic rectangular plate that is hinged on the ends, supported but subjected to elastic rotational restraint on one longitudinal edge, and flanged but otherwise free on the remaining edge. A numerical procedure with a rigorous mathematical basis is proposed for solving elastic stability problems of this type.

24-89. **Influence of Different Factors on Buckling Loads of Curved Thin Aluminum Alloy Sheets for Monocoque Constructions.** Georges Welter. *Journal of the Aeronautical Sciences,* v. 13, April '46, p. 204-208, 217.

Fundamental principles involved in increasing the buckling strength of the sheet. Test results show a 50 to 70% increase in ultimate buckling load obtained by changes in the configuration of the sheet, which resulted in more load being carried in the supported edges and less in the unsupported central region. Although several suggestions are made, practical method of achieving the desired results is left to the ingenuity of the designer.

24-90. **Trunnion Design for Assembly Jigs.** *Tool & Die Journal,* v. 12, May '46, p. 96-97.

Illustrations indicate the design of a trunnion which is a screw-type mechanism which will permit the locating members of a jig to be rotated 180° without difficulty. An index plate and a spring-actuated pin stop make it possible to position the work at any convenient angle in the plane of rotation.

24-91. **Design Considerations for Welded Machinery Parts.** G. L. Snyder. *Transactions of the American Society of Mechanical Engineers,* v. 68, May '46, p. 293-307.

Limitations in processing weldments and scope and limitation of equipment and methods used in their production. Limited to dynamically loaded welded machinery parts.

24-92. **Tessellated Stresses—Part IV.** F. Laszlo. *Iron and Steel,* v. 19, May 10, '46, p. 286-289.

The criterion of making units of structural tessellation self-compensated is the equality of the shear moduli of elasticity of the components, for any possible shape of tessellation. When there is elastic affinity, the units of tessellation prove to be self-compensated also when subjected to an external direct stress.

24-93. **Helical Gears.** Frank Shaw. *Automobile Engineer,* v. 36, May '46, p. 221-229.

Design of the single types for automobile gear boxes.

24-94. **Basic Relationship of Hypoid Gears. Part IV. Tooth Contact.** Ernest Wildhaber. *American Machinist,* v. 90, June 6, '46, p. 110-114.

Method for finding the required tooth profile curvature.

24-95. **Displacement Correction Factors for Rotary Spur Gear Pumps.** W. B. Erichson. *Product Engineering,* v. 17, June '46, p. 440-443.

Influence of tooth clearance, tooth space volume, backlash and pressure angle on pump displacement are analyzed and evaluated. Values of correction factors, for use in a simple general displacement equation, are ob-

tained from planimeter measurements of gear tooth profiles and compared with displacements of hand cranked pumps.

24-96. **Utilizing Residual Forming Stresses in Flat Steel Springs.** W. C. Troy. *Machinery,* v. 52, June '46, p. 152-157.

Effect of residual stresses, resulting from forming operations, on flat steel spring performance and the way in which these stresses can be utilized to improve spring strength.

24-97. **Discussion of "Engineering of Involute Splines".** Charles H. Stanard. *SAE Journal,* v. 54, June '46, p. 310-324.

Discussion supplements main paper, contributing additional information on production problems, effect of interference and index errors and misalignment, broaching as applied to the new standard, and the use of a single radius in place of the involute curve.

24-98. **Considerations Involved in the Accurate Development of Templets.** A. Dickason. *Sheet Metal Industries,* v. 23, June '46, p. 1153-1155.

The neutral line; stresses during bending; bends in duralumin; duralumin end support bracket.

24-99. **Utilizing Mechanical Properties in Die-Casting Design.** Joseph Marin. *Die Casting,* v. 4, July '46, p. 21-22.

Discusses members subjected to static bending stresses.

24-100. **Proper Dimensioning for Parts Drawings.** Milton H. Meyer. *Die Casting,* v. 4, July '46, p. 29-33, 49-50.

Outline of factors that must be considered when dimensioning die-cast parts drawings to obtain the highest possible standards.

24-101. **The Institution of Naval Architects.** *Engineering,* v. 161, May 3, '46, p. 425-426.

Discussions on three papers concerned with design of ship structures, strains, and their measurement in relation to ship construction, and use of welded ship structures.

24-102. **Design of Welded Parts.** Richard J. Wolf and Charles Eiwen. *Product Engineering,* v. 17, July '46, p. 122-124.

Fundamentals of welding design and procedure for incorporating cast, forged and rolled sections into composite structures. Rules for good welding design and comparative data on strength of weld and base metals are given and typical welded parts are illustrated.

24-103. **Stranded Wire Helical Springs for Machine Guns.** H. H. Clark. *Product Engineering,* v. 17, July '46, p. 154-158.

Comparison of spring characteristics and life expectancy with the corresponding properties of conventional helical springs. Effects of number of strands on spring design, deflection, damping and resonance are discussed. Methods of testing, interpretation of test data and observations during manufacture of satisfactory springs are considered.

24-104. **Some Considerations in the Design of Class I Pressure Vessels.** E. J. Heeley. *Institution of Mechanical Engineers Proceedings,* v. 154, June '46, p. 22-32; discussion p. 33-51.

Results of radiographic examinations and studies of the stresses in joints made by the metallic-arc fusion welding process.

24-105. **Designing for Precision Casting.** Richard C. Wynne. *Machine Design,* v. 18, July '46, p. 129-131.

Several noteworthy examples of precision-cast parts are discussed and a few simple rules given relating to design.

24-106. **Stress Gages Simplify Analysis.** Sidney B. Williams. *Machine Design,* v. 18, July '46, p. 132-136, 186-188.

Gages have marked advantages because they aid in solving biaxial stress equations without second measurement or calculation.

24-107. **Basic Relationship of Hypoid Gears. Part 6—Gear Tooth Sliding.** *American Machinist,* v. 90, July 18, '46, p. 106-110.

Lengthwise tooth sliding and profile sliding increase on the pinion addendum with increasing distance from the pitch surface.

24-108. **Design and Mold Assembly of an Aluminum Polishing Head.** J. W. Wheeler. *Modern Metals,* v. 2, July '46, p. 12-15.

Describes a product changeover from sand to permanent molding.

24-109. **Analyzing Stresses in Welded H-Section Trusses.** *Steel,* v. 119, July 22, '46, p. 99, 132.

Strain gages consisting of tiny loops of copper-nickel wire located at 48 points on two 80-ft. trusses measure strains to one millionth of an inch. Electronic equipment amplifies readings for conventional recording devices.

24-110. **Apprentice Cam and Tool Design Series. Part IV.** *Screw Machine Engineering,* v. 7, July '46, p. 48-51.

Turret knurling for Brown & Sharpe automatics.

24-111. **Use of Stainless Steel as a Structural Material in Jet-Propelled Aircraft.** Given Brewer. *Metal Progress,* v. 50, July '46, p. 84-88.

Tables give comparison of physical properties of 18-8 and duralumin and strain gage data obtained from stainless steel shear panel under various loads. Buckling strength of a stainless steel panel is only one-third that of a duralumin panel of equal size and weight.

24-112. **Changeover of a Band Saw to Welded Design.** J. R. Morrill. *Welding Journal,* v. 25, June '46, p. 543-545.

The frame, doors and guards were made of cast iron, with a total weight of 1150 lb. (excluding motor and other electrical equipment). Due to the difficulty in obtaining castings and the high cost of pattern changes when a new model was designed, Grob Brothers of Grafton, Wis., manufacturers of the product, studied the possibilities of welded design. One of the chief advantages of the arc welded design is that it eliminates machining. Many of the holes, formerly drilled, are now punched.

24-113. **Castings and Weldings.** Claude D. Gibb. *Foundry Trade Journal,* v. 79, June 20, '46, p. 179-184, 191.

Modern tendencies in design.

24-114. **The Behavior of Stanchions Bent in Single Curvature.** J. W. Roderick. *Transactions of the Institute of Welding,* v. 9, April '46, p. 67-68.

Work carried out as a continuation of an investigation into the behavior of welded rigid frame structures. The purpose of the investigation is to find the true load-carrying capacity of rigidly jointed steel structures.

24-115. **Designing of "Trouble-Free" Dies. Part 59.** C. W. Hinman. *Modern Industrial Press,* v. 8, July '46, p. 18, 20.

Shaving and burnishing dies.

24-116. **Constant Pressure-Angle Cam With Roller Follower.** F. B. White. *Machinery (London),* v. 69, July 11, '46, p. 47-51.

How the coordinates of a constant pressure-angle cam with roller follower can be calculated.

24-117. **Helical Gears.** Harry Walker. *Engineer,* v. 182, July 12, '46, p. 24-26.

Helical gear action, normally visualized as being based on contact along a series of straight lines bearing a uniform rate of loading, does not in practice conform to this ideal condition. Distortion of the teeth and of the tooth surfaces takes place and the balance of load distribution is disturbed.

24-118. **Design of Exhaust Systems, Part XXIII.** F. H. Stebbins. *Sheet Metal Worker,* v. 37, July '46, p. 49-51.

Additional information on paint spray booths; also hoods and boots.

24-119. **Designing, Drafting, and Using Press Tools.** C. W. Hinman. *Steel Processing,* v. 32, July '46, p. 441-445.

Two types of progressive dies; a typical workpiece and progressive die; designing the details; French stops; finger stops.

24-120. **Nondestructive Measurement of Residual and Enforced Stresses by Means of X-Ray Diffraction.** George Sachs, Charles S. Smith, Jack D. Lubahn, Gordon E. Davis and Lynn J. Ebert. *Welding Journal,* v. 25, July '46, p. 400s-412s.

Two selected problems were investigated in detail. The X-ray diffraction method revealed some fundamentally important facts regarding *(a)* the stress distribution in structures containing sudden section changes and subjected to elastic or plastic straining, and *(b)* the stress distribution within the bead of a weldment. However, the X-ray method does not appear sufficiently developed at the present to meet the requirements of a practical method of stress measurement. (Taken from National Advisory Committee for Aeronautics—Technical Note no. 986, Sept. 1945.) 73 ref.

24-121. **Helical Gears.** Harry Walker. *Engineer,* v. 182, July 19, '46, p. 46-48.

Surface stresses; effect of spiral angle and pressure angle; pitting of helical teeth; machine for pitting test.

24-122. **Patterns for Irregular Bodies of Unequal Taper.** J. B. Clegg. *Sheet Metal Industries,* v. 23, July '46, p. 1343-1347.

Satisfactory results of precision development demonstrated in manufacture of domestic appliance where three different irregular tapered pieces are used. All three are of 20-s.w.g. material and the quantities required were sufficient to justify a considerable amount of tooling. Main tools were: blanking dies, forming blocks, welding fixtures and press tools for final shaping including the flaring-off of flanges and drawing of skirts. 21 ref.

24-123. **Reinforcement of Branch Pieces.** J. S. Blair. *Engineering,* v. 162, July 5, '46, p. 1-4.

It is generally recognized that when a hole is cut in a pipe for the introduction of a branch, the pipe is weakened against the effects of internal pressure. A suitable relationship was found from which the strength of any form of unreinforced branch piece could be determined, and a type of welded triform reinforcement was designed which proved more than adequate, making the branch piece in fact stronger than the corresponding straight pipe.

24-124. **Basic Relationship of Hypoid Gears. Part 7—Skew Hypoid Gears.** Ernest Wildhaber. *American Machinist,* v. 90, Aug. 1, '46, p. 104-106.

Gears to rotate on offset axes and provided with skew teeth were a problem which resisted analysis until treated as a special case of hypoid gears.

24-125. **Weight Estimation for Die Castings, Part I.** H. K. and L. C. Barton. *Die Casting,* v. 4, Aug. '46, p. 19-20, 46-47.

Method for arriving at an accurate figure in calculating the weight of a die casting from the blueprint. (Reprinted from *Machinery [London]*).

24-126. **Helical Gears, No. III.** Harry Walker. *Engineer,* v. 182, July 26, '46, p. 70-71.

British standard specifications for helical gears; effect of face width; comparative stresses in spurs and helicals; comparison between helical and spur gear action; profile modification of helical gears.

24-127. **Residual Stresses Can Be Beneficial or Might Cause Failure of Part.** J. O. Almen. *Product Engineering,* v. 17, Aug. '46, p. 81-85.

Residual stresses may be an asset or a liability, depending on their relation to the stress pattern of the working load. Charts show how stress raisers and stress-corrosion affect the life of parts, and curves relate the life of parts to human life expectancy.

24-128. **Design of Weldments for Best Results at Lowest Costs.** I. A. Oehler. *Product Engineering,* v. 17, Aug. '46, p. 86-89.

How the use of standard and special rolled shapes, proper shop equipment and sound design techniques achieve superior parts at lower costs. Salient features of good welding design and their application in the design and fabrication of a few parts.

24-129. **The Tool Engineer and the Time Element.** E. A. Cyrol. *Tool Engineer,* v. 17, Aug. '46, p. 41-44.

Savings in time that the tool engineer can design into a jig or fixture cannot be realized in any other way.

Tables of time values for various operations illustrate where savings can be effected by design changes.

24-130. **Thin Stock Demands Special Die Design.** Wallace C. Mills. *American Machinist,* v. 90, Aug. 15, '46, p. 112-115.

Dies for stock under 0.020 in. thickness differ in construction details from thick-metal dies. Reference drawings provide guide for die designers.

24-131. **Basic Relationship of Hypoid Gears. Part 7—Design for Duplex Cutting.** Ernest Wildhaber. *American Machinist,* v. 90, Aug. 15, '46, p. 122-128.

Procedure is intended specifically for hypoid gear pairs in which both members are generated and where both sides of a tooth space are simultaneously cut with a face-mill cutter. Can also be applied to gear pairs where opposite tooth sides are separately generated on the pinion and to formate gear pairs.

24-132. **Wide Range of Designs Fit Roller Bearings to Each Application.** C. W. Pearsall. *Power,* v. 90, Aug. '46, p. 74-76, 144, 146, 148.

Multiplicity of designs meet practically unlimited conditions of shaft loads and their directions, rotative speeds, space limits and other factors. Selection of the best design for each duty.

24-133. **Continental Finds Stresscoat Analysis Valuable Guide in Redesigning Engine Parts.** Joseph Geschelin. *Automotive and Aviation Industries,* v. 95, Aug. 15, '46, p. 36-39, 100.

Stresscoat method is a short cut to optimum design since the static test gives results analogous to dynamic loading. Permits of a rapid approach to the final design since the redesigned part can be analyzed quickly in the laboratory to determine the effectiveness of corrective measures.

24-134. **Short-Cut Formulas for Designing Structural Steel Frames.** S. Reibel. *Heating and Ventilating,* v. 43, Aug. '46, p. 68, 82.

Rules enable the engineer to select the proper size angle iron without reference to structural steel tables or handbooks for column or post, load-carrying brace and strength of a column.

24-135. **Stamping Machine Parts.** Colin Carmichael. *Steel,* v. 119, Aug. 26, '46, p. 74-75, 94, 96, 99.

Discusses problems facing the designer as he prepares to specify the material and manufacturing methods for a new part.

24-136. **Designing of "Trouble-Free" Dies.** C. W. Hinman. *Modern Industrial Press,* v. 8, Aug. '46, p. 18.

Shaving and burnishing dies.

24-137. **Stress Diffusion Problems. (Continued.)** W. J. Goodey. *Aircraft Engineering,* v. 18, July '46, p. 227-230.

A mathematical analysis of various accurate solutions of the problem of the reinforced panel by using the stress-function.

24-138. **Simulated Forgings.** Lawrence J. Barker. *Light Metal Age,* v. 4, Aug. '46, p. 8-11.

Use of simulated (machined) forgings eliminates cost of expensive dies in experimental design. Considerations essential to obtaining correct design values for strength.

24-139. **The Relationship Between the Dimensions of Containers When Constructed With a Minimum Amount of Material for a Given Capacity.** Kenneth L. Jackson. *Sheet Metal Industries,* v. 23, Aug. '46, p. 1517-1524.

Equations for cylindrical container with conical top; n-sided box; circular solid drawn shell with corner radius; square topped biscuit tin; domed paste tin; square shouldered oil bottle; rectangular solid drawn box with corner and bottom radii.

24-140. **Considerations Involved in the Accurate Development of Templets.** A. Dickason. *Sheet Metal Industries,* v. 23, Aug. '46, p. 1554-1556.

Diaphragm shown is typical example of a small sheet metal fitting which can be developed accurately by calculation. Method of calculating the length of the neutral line is shown. Material is 16 s.w.g. duralumin, and the inside radius of the bend is taken as 2t.

24-141. **Electric Resistance Wire Strain Gages.** *Engineering,* v. 162, Aug. 9, '46, p. 121-123.

New developments in strain gage technology, basic principles, and design principles for various applications.

24-142. **New Principle Developed in Thread Ring Gage Design.** A. H. Allen. *Steel,* v. 119, Sept. 2, '46, p. 112, 115, 146.

New principle in design of adjustable thread ring gages arrived at after extensive experiments with many various modifications of conventional type of ring gage. Each design was studied in detail from point of view of both production and the maintenance of roundness on adjustment. Ultimate design eliminates old types altogether, and comprises four parts.

24-143. **Design and Fabrication of Welded Steel.** John Austin. *Industry and Welding,* v. 19, Aug. '46, p. 36-39, 50.

Design problems necessary for good foundry procedure can be eliminated by use of brakes to reduce fabricating time and use of supplementary fabrication such as spot flame hardening where necessary. Reduction of weight and increase of strength are thus achieved.

24-144. **Design of Mill Tables.** James G. Meenan. *Iron and Steel Engineer,* v. 23, Aug. '46, p. 53-59.

Recommendation given for tables with line shaft driven rollers and those with individually driven rollers. Table rollers; line shafts; line shaft and roller gears; girder and bed plates; power units; lubrication system and lubricants.

24-145. **Welded Sections. Shear Stresses in Plate Girders.** H. Gottfeldt. *Welding,* v. 14, Aug. '46, p. 376-381.

24-146. **Weight Estimation for Die Castings. Part 2.** H. K. and L. C. Barton. *Die Castings,* v. 4, Sept. '46, p. 19-20, 54.

In calculating the weight of die castings from the original blueprint, it is necessary to determine the volumes of component forms. Methods for obtaining these are presented.

24-147. **A Redesigned Drafting Machine.** *Die Castings,* v. 4, Sept. '46, p. 22-24, 41-42, 44-45.

Greater resistance to stress, increased rigidity and flatness, plus lighter weight, are among the reasons why the Universal drafting machine has been re-engineered for die castings.

24-148. **Portability Plus.** *Die Castings,* v. 4, Sept. '46, p. 28-30, 51-52.

Some details of redesign of a heavy duty ½-in. drill, in which weight and size were approximately halved, partly through the application of aluminum die castings in place of sand castings; and a new ¼-in. drill designed with some very light skeleton-like aluminum die castings to act as a main frame inside a housing molded from plastic having high impact strength as well as light weight.

24-149. **Hobbed Gear Tooth Layout Simplified—I.** Clyde A. Young. *American Machinist,* v. 90, Sept. 12, '46, p. 133-135.

Time in gear design may be saved by finding a point common to the centerlines of the generating tooth and the tooth space.

24-150. **Improving Engine Parts by Direct Measurement of Strain.** R. G. Anderson. *S.A.E. Journal,* v. 54, Sept. '46, p. 466-475, 502.

Interpretation of some of the results of stress analysis, including a few of the many methods whereby the life of machine parts can be improved. In designing it is important to proportion parts so as to take advantage of beneficial prestress.

24-151. **Design and Fabrication of Welded Steel Reduction Gear Drives.** George L. Snyder. *Welding Journal,* v. 25, Aug. '46, p. 699-703.

Describes production of large-size gears, gear housings and turbine cases with particular reference to marine applications. Shows graphically deflection characteristics of spoked and cone web gears. Stress relieving is an essential part of process.

24-152. **Designing, Drafting and Using Press Tools.** C. W. Hinman. *Steel Processing,* v. 32, Aug. '46, p. 515-518.

Standard E and I core laminations for radio transformer amplifying coils from silicon steel strips, 0.016 to 0.018-in. gage. Two E's and two I's are pierced, blanked, and evenly stacked in chutes by each progressive die, and eight sizes of laminations are made.

24-153. **Large Gas Holders at Long Beach Feature All-Welded Construction.** H. O. Hill. *Welding Journal,* v. 25, Aug. '46, p. 745-746.

Design, construction and testing of four 175,000-cu.ft. holders suitable for pressure of 55 psi.

24-154. **Stresses in Cylindrical Glass-Metal Seals With Glass Inside.** Albert W. Hull. *Journal of Applied Physics,* v. 17, Aug. '46, p. 685-687.

Stresses are calculated for a solid glass cylinder sealed to the inside of a metal cylinder. It is shown that the stresses are all of the same sign so that a moderate mis-

match in thermal expansion, with the metal expansion the greater, is allowable and perhaps desirable.

24-155. **Strain Analysis by Photogrid Method.** W. F. Brown, Jr. and M. H. Jones. *Iron Age,* v. 158, Sept. 12, '46 p. 50-55.

Use of photogridding for strain analysis, the technique of applying the grid to a metal surface and subsequent strain measurement. Method involves application of a light sensitive emulsion to the metal surface, contact printing of a negative of the required grid and final development of the grid in an ordinary black dye solution.

24-156. **Comparison of Layout Methods Used for Cam Design.** *Screw Machine Engineering,* v. 7, Sept. '46, p. 49-51.

Detailed study of procedure of designing cams by the written method.

24-157. **Chart Method of Computing Drill Pullout Lobes.** *Screw Machine Engineering,* v. 7, Sept. '46, p. 52-56.

Charts compiled to work in conjunction with the written method of cam design for the Brown and Sharpe automatic screw machines. Use of charts provides a means of determining the necessary hundreds of cam spaces required for drill pullout lobes.

24-158. **Designing Tools for Screw Machine Production.** *Screw Machine Engineering,* v. 7, Sept. '46, p. 44-47.

Design of circular tooling; standard circular cutoff tools; standard circular chamfer tools; single radius circular cutoff tools; circular cutoff and chamfer tools; workpiece angles converted to tool angles.

24-159. **Stress and Strain in Plastic Flow.** W. P. Roop. *Welding Journal,* v. 25, Sept. '46, p. 799-823.

Presents a point of view which contemplates systematic consideration of plastic action in steel not unlike that which has been developed in the course of many years for elastic action and applied to ship design. Intended to assist in the digestion of the numerous data on special phases of plasticity now available and to show their relation to the design of ship structures. Emphasizes principally the points at which the treatment of plastic action differs from the familiar treatment of elastic action. Proceeds by easy stages from the simple case of tension in a wire toward the intricacies of triaxial action and localized distribution. 10 ref.

24-160. **The Opening of a Griffith Crack Under Internal Pressure.** I. N. Sneddon and H. A. Elliott. *Quarterly of Applied Mathematics,* v. 4, Oct. '46, p. 262-267.

Determination of distribution of stress in the neighborhood of a crack in an elastic body is of importance in the discussion of certain properties of the solid state. Discusses distribution of stress in the neighborhood of a Griffith crack which is subject to an internal pressure. Method is given for determining shape of the crack resulting from the application of variable internal pressure to a very thin crevice in the interior of an elastic solid, and for determining distribution of stress throughout the solid

24-161. **The Measurement of Straight-Flanked Helicoids.** J. W. Drinkwater. *Machinery (London),* v. 69, Aug. 22, '46, p. 235-240.

Accurate calculation of tooth form; how accurate is the virtual circle; approximate formulas.

24-162. **Utilizing Mechanical Properties in Die-Casting Design. Part 3. Members Subjected to Static Torsional Stresses.** Joseph Marin. *Die Castings,* v. 4, Oct. '46, p. 27-28.

Design of members subjected to torsion; restricted to torsional members subjected to static loads.

24-163. **A New Twist on an Old Design.** *Die Castings,* v. 4, Oct. '46, p. 35.

New design for bobbin fingers used in textile machinery eliminates a large number of finishing operations.

24-164. **Machine Tools of Tomorrow—Part 3.** Gosta R. Truedsson. *American Machinist,* v. 90, Oct. 10, '46, p. 136-137.

Design considerations with relation to chip and coolant needs.

24-165. **Designing of "Trouble-Free" Dies. Part LXI. Shaving the Edges on Thick Blanks and Castings.** C. W. Hinman. *Modern Industrial Press,* v. 8, Sept. '46, p. 18, 34.

Centralizing and ejecting the work; shaving blanks in compound dies; shaving castings and forgings.

24-166. **Torque Values for Standard AN Bolts and Nuts.** *Iron Age,* v. 158, Oct. 10, '46, p. 59.

Series of tests on standard AN nuts and bolts with the objective of setting standard AN nuts for design requirements and safety with respect to the strength of the material. Two different groups of tests were conducted. For the first group the torque was applied to the nut, and for the second group to the bolt head. In each group four different sets of conditions were established, corresponding to different applications. Results are tabulated.

24-167. **Copper Furnace Brazed Parts and Principles of Design.** Kenneth Schmidt. *Product Engineering,* v. 17, Oct. '46, p. 103-107.

Positive information for guidance in the design of parts to be fabricated by copper brazing, including details for placing the copper and the degree of tightness of joint for best results. Importance of venting and types of vents; comparative data on costs.

24-168. **Machine Tools of Tomorrow. Design Considerations.** Gosta R. Truedsson. *American Machinist,* v. 90, Sept. 26, '46, p. 122-123.

Location of the motors and of electrical and hydraulic controls should be made with an eye to safety and ease of maintenance.

24-169. **Hobbed Gear Tooth Layout Simplified.** Clyde A. Young. *American Machinist,* v. 90, Sept. 26, '46, p. 130-131.

How to find the point where the tooth space centerline intersects the centerline of the hob tooth. Includes tables giving relation between the constant C_1 and the pitch radius.

24-170. **Magnesium Alloys for Aircraft. Part 2.** F. A. Rappleyea. *Aero Digest,* v. 53, Sept. '46, p. 87-88, 91, 110.

Past weight-saving studies in column design based on Euler's formula were valid only for long columns, which are seldom used today. Gives mathematical derivation for tubular columns for three cases and compares aluminum and magnesium alloys. The equations are applied to typical alloys and results presented in tables and graphically.

24-171. **Patterns for Irregular Bodies of Unequal Taper.** J. B. Clegg. *Sheet Metal Industries,* v. 23, Sept. '46, p. 1769-1772.

Development of a tapered top to be welded onto a casing of which the main skirt is of parallel form of the same section as the base profile of this cone.

24-172. **Stress Analysis of Tube Sinking.** George Sachs and W. M. Baldwin, Jr. *Transactions of the American Society of Mechanical Engineers,* v. 68, Aug. '46, p. 655-662.

Theoretical stress analysis made of the tube sinking operation, equations being set up to yield the sinking stress as a function of the reduction in mean diameter. Equations confirmed by experimentation on annealed and full hard copper and on annealed tube brass for conical dies of various tapers. Coefficients of friction existing during tube sinking determined and found to be of the same magnitude as those determined previously for wiredrawing. 17 ref.

24-173. **Cam Designed to Operate on Alternate Revolutions.** *Machinery (London),* v. 69, Sept. 19, '46, p. 370-371.

Design of a cam that transmits an irregular oscillating motion to a shaft on each alternate revolution of the camshaft.

24-174. **Special Slide Rule Solves Gage Design Problems.** B. B. Patton. *Iron Age,* v. 158, Oct. 24, '46, p. 52-54.

All of the lengthy problems and calculations involved in gage design can be solved by the use of a special type of slide rule calculator recently designed for use of gage engineers at Frankford Arsenal.

24-175. **Raised (?) Yield Point in Bend Tests.** T. J. Dolan and O. Sidebottom. *Metal Progress,* v. 50, Oct. '46, p. 653-657.

Reviews significance of experimental curves and data presented in "Raised Yield Strength in Bend Tests", by Given Brewer, which appeared in the Dec. '45 issue. Deals mainly with difficulties of detecting the load at which yielding started in the most stressed fiber, and erroneous interpretation of the test data.

24-176. **Internal Friction in Engineering Materials.** J. M. Robertson and A. J. Yorgiadis. *Journal of Applied Mechanics,* v. 13, Sept. '46, p. A173-A182.

Report on some experiments conducted on the subject of internal friction or damping in solid engineering materials, with apparatus and technique comparatively new. Empirical relations are presented for the variation of internal friction with stress amplitude in the range of engineering stresses. These relations are compared with the findings of others.

24-177. **Analytical Expressions for Principal Strains.** W. T. Thomson. *Journal of Applied Mechanics,* v. 13, Sept. '46, p. A221-A222.

Recent methods by G. Murphy and N. J. Hoff enable the graphical evaluation of principal strains from strains measured along any three intersecting lines. When the two angles between gage lines are equal, the principal strains may be determined from simple analytical expressions without reference to the graphical solution.

24-178. **Flat Spring With Large Deflections.** F. Hymans. *Journal of Applied Mechanics,* v. 13, Sept. '46, p. A223-A230.

Analysis of a flat spring initially curved and inserted in the apparatus of which it is an element in a buckled condition. Ascertains the various possible shapes of the buckled spring and the forces associated with them. Shows how, by a suitable variation of parameter shapes, two or more points of inflection may be obtained.

24-179 **Calculation of Stress in Crane Hooks.** A. M. Wahl. *Journal of Applied Mechanics,* v. 13, Sept. '46, p. A239-A242.

Two methods for calculating stress in crane hooks which have given good results in practice are described. One method, based on a numerical integration of the curved-bar equations, involves only slide-rule accuracy and may be used for irregular shapes or cross section. Second or analytical method is applicable to hooks having sections which do not deviate too much from the trapezoidal form. Comparison of results indicates that the analytical method is sufficiently accurate for most purposes.

24-180. **Ductility of Metals and Alloys Used in Construction.** George Welter. *Metallurgia,* v. 34, Sept. '46, p. 233-237.

Results of tests made of light metals and alloys in comparison with other heavy structural materials. Standard and special notched specimens were tested under axial and eccentric loads producing a single tension as well as combined tension and bending stresses.

24-181. **A Method of Calculating the Maximum Stress in the Web of Rail Due to an Eccentric Vertical Load.** C. J. Code. *American Railway Engineering,* v. 48, no. 461, Sept-Oct. '46, p. 123-127.

Method is principally empirical, and is based on a series of tests conducted at the Altoona laboratories of the Pennsylvania Railroad, using Stresscoat to determine the location of maximum stress and wire resistance strain gages to determine the magnitude of the stress. Four curves are presented, two for use in calculating bending stress and two for calculating direct stress.

24-182. **Designing Tools for Screw Machine Production. Part II.** *Screw Machine Engineering,* v. 7, Oct. '46, p. 62-64.

Two methods of tool design for corner breaks; tool calculations for chamfers on hexagon parts; combined radius and angle chamfers.

24-183. **Greater Accuracy From Advanced Ring Gage Design.** Gerald Eldridge Stedman. *Production Engineering & Management,* v. 18, Oct. '46, p. 61-64.

Design improvement of this adjustable thread ring gage provides greater stability and accuracy with less weight, positive adjustment and longer life.

24-184. **Considerations Involved in the Accurate Development of Templets.** A. Dickason. *Sheet Metal Industries,* v. 23, Oct. '46, p. 1961-1964.

Shows a motor support box as used on one of the large bombers produced during the war, and represents a typical problem of templet development arising from detail drawings such as are usually supplied to contractors. Drawing contains all the main essentials in the matter of measurements. Frame diagram may be drawn from the measurements given, but for purposes of calculating the length of the neutral line, or the developed length of the blank for the outer casing, it is necessary to obtain the lengths of the other two sides of the frame diagram, and also the two remaining angles.

24-185. **Machine Tools of Tomorrow. Part 4. (Concluded.)** Gosta R. Truedsson. *American Machinist,* v. 90, Oct. 24, '46, p. 118-119.

Hydraulic hold-downs, improved table lubrication and growing use of plastic parts.

24-186. **Can Compression Stress Cause Fatigue Failure?** John C. Straub. *American Machinist,* v. 90, Oct. 24, '46, p. 120.

Proposes modification of the statement that all fatigue failures are a result of tension stresses, showing actual failure may be caused by compression. Discusses stresses in simple bending.

24-187. **Poisson's Ratio of Some Structural Alloys for Large Strains.** Ambrose H. Stang, Martin Greenspan, and Sanford B. Newman. *Journal of Research of the National Bureau of Standards,* v. 37, Oct. '46, p. 211-212.

Values of Poisson's ratio, as well as ordinary stress-strain properties, for tensile strains as high as 18%, were determined on sheets of aluminum alloys 24 S-T and 24 S-RT, chromium-molybdenum steel plate, and structural and fully killed low-carbon steel plate. Test methods and graphical and tabular presentation of results.

24-188. **Designing of "Trouble-Free" Dies. Part 2.** C. W. Hinman. *Modern Industrial Press,* v. 8, Oct. '46, p. 20.

Blanking and shaving simultaneously.

24-189. **Good Design, Proper Fabrication Make High-Temperature Piping System Safe: II.** Sabin Crocker. *Power,* v. 90, Nov. '46, p. 68-71, 156, 158, 162.

Know-how in flexibility calculations, metallurgical research, and fabricating skill tend to reduce costs, better the job.

24-190. **How Design Affects Heat Treatment—1 & 2.** *American Machinist,* v. 90, Nov. 7, '46, p. 145, 147.

A number of drawings illustrate various correct and incorrect practices in the design of parts, from the point of view of defects likely to appear in heat treating.

24-191. **Spot Welding Design Data.** Frederick S. Dever. *Product Engineering,* v. 17, Nov. '46, p. 105-109.

Limits for edge distances and for distances between adjacent spot welds, limiting diameters of spot welds, types of spot welded joints and the efficiencies of such

joints are defined in terms of material thickness. Selected information of general interest to designers about spot welding and the inspection of spot welds is included.

24-192. **Weight Estimation for Die Castings. Part 3.** H. K. Barton. *Die Castings,* v. 4, Nov. '46, p. 19-20.

Methods for obtaining the volumes of component forms when calculating the weight of die castings from the original blueprint.

24-193. **Methods for Measuring Stress and Strain in Solids.** *Nature,* v. 158, Oct. 19, '46, p. 537-539.

Abstracts of several papers presented at a conference of the Manchester branch of the Institute of Physics. The use of the electric resistance strain gage and the electrical systems used in different circumstances are covered.

24-194. **Plastic Strain in Isotropic Strain Hardening Material.** H. W. Swift. *Engineering,* v. 162, Oct. 18, '46, p. 381-384.

An equation for elastic resilience is developed by mathematical treatment of the geometry of strain. The relationships between stress and strain in a hypothetical material which hardens under plastic distortion are examined. It is assumed that elastic strength in any given condition is defined by shear resilience. Analysis indicates that strain hardening rate under given average shear stresses is independent of the stress system if the mode of strain hardening conforms to certain limitations not demanded by the conditions of isotropy.

24-195. **Welded Frame Building Designed for Heavy Loads.** Mark Falk. *Engineering News-Record,* v. 137, Nov. 14, '46, p. 98-100.

Fully continuous welded steel construction was used to good advantage in the design of a three-story building with heavy loading. Compared with ordinary steel design, a saving in amount of steel was effected by careful attention to design of details for most advantageous use of welding.

24-196. **Designing Tools for Screw Machine Production.** *Screw Machine Engineering,* v. 8, Nov. '46, p. 56-59.

Preventing objectionable rings when combining form and turning operations; form tool facing; combination tooling.

24-197. **Field Erected Pressure Vessels.** Fred L. Plummer. *Welding Journal,* v. 25, Nov. '46, p. 1081-1089.

Some of the factors which influence the economy and safety of large pressure vessels used for storage. Describes several cases of failures of such equipment and makes recommendations for future construction of such vessels. 13 ref.

24-198. **Recent Trends in Concepts of Design for Welded Steel Structures.** LaMotte Grover. *Welding Journal,* v. 25, Nov. '46, p. 1091-1108.

Effects of notches and other forms of stress-raisers shown by diagrams; comparative freedom from failure of different ship designs. Effect of low temperatures on behavior of structural members is shown graphically. Also

discusses influence of proportional limit, yield point and plastic deformation. Reviews results of box-girder tests at Bureau of Standards, drop-hammer flexural impact tests of rolled beams with butt-welded splices at Columbia, the behavior of steels subjected to repeated stress and the design of members and connections for fatigue loading as investigated by the Welding Research Council at University of Illinois.

24-199. **Influence of Geometrical Restraint and Temperature on the Toughness and Mode of Rupture of Structural Steel.** Arthur R. Anderson and Alvin G. Waggoner. *Welding Journal,* v. 25, Nov. '46, p. 789s-801s.

Attempts to approach problem from viewpoint of the design engineer. In Part I, behavior of ¼-in. medium structural steel plates under static tensions at temperatures ranging from +80 to −80° F. and geometrical restraints through the introduction of several patterns of welding were investigated. In Part II, a new type of test specimen for testing butt welds under biaxial tension is described and in Part III, behavior of the microstructure of the steel under uniaxial and biaxial tension at different temperatures is explained.

24-200. **Determination and Presentation of Compressive Stress-Strain Data for Thin Sheet Metal.** Walter Ramberg and James A. Miller. *Journal of the Aeronautical Sciences,* v. 13, Nov. '46, p. 569-580.

Various methods of obtaining the compressive stress-strain curve of thin sheet metal and their advantages and limitations. Presentation of stress-strain data in dimensionless form; advantages of such a presentation in correcting for the effect of variations in yield strength and in Young's modulus. Attention is called to a classification of stress-strain curves by shape factors following a three-parameter formula proposed by Osgood. 20 ref.

24-201. **The Effect of Radius of Curvature and Preliminary Artificial Eccentricities on Buckling Loads of Curved Thin Aluminum Alloy Sheets for Monocoque Constructions.** Georges Welter. *Journal of the Aeronautical Sciences,* v. 13, Nov. '46, p. 593-596, 604.

Sheets of aluminum alloy tested under special conditions offer highly increased buckling and ultimate strengths under compression loads. Local eccentricities of the curved panels, generally assumed to be exceedingly detrimental to the bearing capacity in compression, did not decrease the buckling load of the panels. Even holes produced by shooting bullets through the panels did not weaken materially their normal buckling strength or their ultimate resistance.

24-202. **Development of Balanced Proportion Rolled Bearings for Rolling Mills.** Paul Haager. *Iron and Steel Engineer,* v. 23, Nov. '46, p. 62-72.

Experience and research have been combined in the evolution of improved bearing designs which have shown greater capacity and rigidity. Factors of larger necks, greater bearing capacity and improved fillets must be balanced by carefully selected mill roll characteristics.

24-203. **Bearing Seals.** L. G. Krug. *Iron and Steel Engineer,* v. 23, Nov. '46, p. 77-81; discussion, p. 82.

Materials for and design of bearing seals for steel mill machinery.

24-204. **Forging Die Design.** John Mueller. *Steel Processing,* v. 32, Nov. '46, p. 712-714.

Die design for forging automobile connecting rod.

24-205. **Designing, Drafting and Using Press Tools.** C. W. Hinman. *Steel Processing,* v. 32, Nov. '46, p. 724-729.

Diagrams show design of dies for cutting large steel blanks. Operations are described.

24-206. **Vertical Sheet Construction Featured in New St. Petersburg Gas Holder.** George C. Pfaff. *Gas Age,* v. 98, Nov. 28, '46, p. 25.

Design features of 2,000,000-cu. ft. all-welded gas holder which can withstand 100 miles per hr. wind velocity.

24-207. **Some Experiments on the Distribution of Deflection and Stress in Thin Flat Plates.** H. D. Conway and V. C. Davies. *Sheet Metal Industries,* v. 23, Nov. '46, p. 2147-2151.

Circular plates loaded with a uniform pressure and supported at four points equidistant from the center, the position of the supports being varied in order to determine the effects. The problem of a uniformly loaded plate with a single central support is the special case met with when the four supports become coincident at the center. (To be continued.)

24-208. **Patterns for Irregular Bodies of Unequal Taper.** J. B. Clegg. *Sheet Metal Industries,* v. 23, Nov. '46, p. 2165-2168.

Calculation of the design of above patterns of a particular type. Illustrated.

24-209. **The Conversion of Sheet Steel to Cylindrical Forms.** J. H. Mort. *Sheet Metal Industries,* v. 23, Nov. '46, p. 2173-2174.

Some useful methods of calculation.

24-210. **The Brittle Lacquer Method for Estimating Stress Distribution in Welded and Riveted Joints.** R. F. Tylecote. *Sheet Metal Industries,* v. 23, Nov. '46, p. 2194-2198.

Specimens were made in 18-gage sheet aluminum alloy containing 3.5% magnesium (B.S.S.L. 46). Three types of specimen were used: first, a row of six welds; second, a row of four rivets, one with an overlap of ½ in., and another with an overlap of 1 in.; and third, a "mixed" joint consisting of four welds and three rivets, the rivets being placed one at each end and one in the middle.

24-211. **Utilizing Mechanical Properties in Die Casting Design. Part IV. Members Subjected to Bending and Axial Loads.** *Die Castings,* v. 4, Dec. '46, p. 25-26.

Strength of short members subjected to bending and axial loads; strength of columns subjected to concentric loads; strength of columns subjected to eccentric loads.

24-212. **Experimental Stress Analysis Symposium.** *Product Engineering,* v. 17, Dec. '46, p. 121-136.

Symposium of case histories wherein the application of

experimental stress analysis resulted in design improvements. Brittle coating or Stresscoat technique; field of photo-elasticicy.

24-213. **High-Capacity Hydraulic Presses.** E. A. Randich. *Machine Design,* v. 18, Dec. '46, p. 137-142.

Considerations and factors involved in design of hydraulic presses and auxiliary equipment.

24-214. **Nomograph Aids Determination of Torsional Stresses in Shafts.** Carl P. Nachod. *Machine Design,* v. 18, Dec. '46, p. 157-158.

Two equations are given, one from which nomograph of five scales is made. Tells how to construct nomograph with use of both equations.

24-215. **Hobbed Gear Tooth Layout Simplified. Part III.** Clyde A. Young. *American Machinist,* v. 90, Dec. 19, '46, p. 133.

Additional values cover small numbers of teeth and amplify tables.

24-216. **Interrupted Rotating Motion With Quick Take-Up Action.** *Machinery (London),* v. 69, Nov. 14, '46, p. 631-632.

Mechanism has purpose of transmitting motion to the gear from the shaft in such a manner as to have the rotary motion of the gear temporarily interrupted for a short, definite period followed by a quick take-up rotary motion which recovers the motion lost during the idle or interrupted period. Mechanism is incorporated in a machine that produces a woven-wire fabric.

24-217. **Theory and Practice of Gear Generating.** *Steel,* v. 119, Dec. 23, '46, p. 54-55, 101.

How to design gear teeth for maximum smoothness of transmitted motion.

SECTION XXV

MISCELLANEOUS

25-1. **High Temperature Gas Turbine Power Plants.** J. S. Javerstick and A. M. G. Moody. *Blast Furnace & Steel Plant,* v. 33, Dec. '45, pp. 1546-1550, 1570.

Study of possibilities of using air from compressor to cool parts of turbine which are subjected simultaneously to high stress and high temperature. Findings discussed.

25-2. **Electronic Applications in Industry.** W. Sommer. *Electronic Engineering,* v. 17, Nov. '45, pp. 777-779.

Results of survey on present and possible uses of electronic equipment in U.S. For each industry is listed number of devices in use, number of firms using devices, and number of unsolved problems requiring electronic solutions. Metal working industry ranks high.

25-3. **The Development of Atomic Energy, Part II.** Andrew W. Kramer. *Power Plant Engineering,* v. 49, Nov. '45, pp. 100-104.

Describes in detail design and construction of first self-sustaining nuclear reaction pile at the University of Chicago.

25-4. **Weights of Small Seamless Copper Tubes.** *Materials & Methods,* v. 22, Dec. '45, p. 1787.

Given in pounds per linear foot.

25-5. **Silicosis Prevention.** W. J. Rees. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 550-551.

Non-siliceous mold and core paints, washes, and parting powders.

25-6. **Research on Cast Iron.** *Engineering,* v. 160, Dec. 14, '45, p. 504.

Brief summary of types of investigations being carried out by British Cast Iron Research Association.

25-7. **The Iron and Steel Industry.** *Metallurgia,* v. 33, Dec. '45, pp. 94-100.

Reference to some of the papers presented at the technical sessions and to the discussions which followed.

25-8. **Assembling Small Parts.** *Steel,* v. 118, Jan. 14, '46, pp. 86-89.

Description of production line for bomb fuses provides manufacturers with excellent suggestions for the more

efficient assembly of peacetime products and closer control over quality.

25-9. **General Review of German Metallurgical Practices.** John H. Frye. *Metal Progress,* v. 49, Jan. '46, pp. 76-86.

Politics interfered with production; "pipe line" held one year's production; designs for very heavy tanks; use of low grade iron ores; improvements in bessemer practice; duplex steel; Hermann Goering steel plant; inadequate transportation; damage by bombing; alloy shortages; vanadium from 0.1% ore; cast iron projectiles; cast gun tubes and armor; precision and die casting; forging practice; powder metallurgy; iron rotating bands for projectiles; physical tests for iron compacts; rolled and drawn bars.

25-10. **Parts and Metal-Forms.** Fred P. Peters. *Materials and Methods,* v. 23, Jan. '46, p. 101-104.

Precision castings, die castings, other types; forgings; weldments and brazed assemblies; stampings, drawn parts, extrusions; tubular products; powder metallurgy parts.

25-11. **Research and Development in the Ordnance Department, U. S. Army.** *Journal of Applied Physics,* v. 16, Dec. '45, p. 745-806.

Research—its coordination and application in the development of ordnance materiel; ammunition research and development; artillery materiel; small arms and small arms ammunition; rockets and missiles; tank and automotive development; aircraft armament; some recent advances in ballistics; ferrous metallurgical research; nonferrous metallurgical research at Frankford Arsenal; military explosives and propellants; fuels and lubricants.

25-12. **Standardization of Color Finishes for Machinery and Equipment.** D. L. Hadley and C. B. Ryder. *Steel,* v. 118, Jan. 28, '46, p. 121-122, 184-186.

Use of four standard grays affords more pleasing appearance, better visibility, and elimination of difficulty in matching colors when replacing parts or repainting equipment. Conclusions follow analysis of possibilities for standardization by Westinghouse and General Electric stylists.

25-13. **Roll Out the Bar Stock.** J. W. Ingraham. *American Machinist,* v. 90, Jan. 31, '46, p. 86-87.

Conveyor carriage and racks end problems in handling toolsteel bar stock in toolroom stores.

25-14. **War Turns a Page in Metal Processing.** *American Machinist,* v. 90, Jan. 31, '46, p. 89-104.

Developments having to do with metals; heat treating; welding; finishing.

25-15. **Applications of Woven Wire Conveyor Belts: Part I.** Fred L. Hooper. *Industrial Heating,* v. 13, Jan. '46, p. 79-80, 82, 84, 86, 88.

Design, construction, maintenance and operation of industrial woven wire conveyor belts. Special attention is given to the different materials of construction available, and how the design of a particular construction coupled with the inherent heat and corrosion resistance of the material of construction affects ultimate belt life. The nu-

merous ways in which such belts can be installed to meet almost any requirements of space traveled, type of material handled, and so on.

25-16. **Automobile Engineering Research.** *Engineering,* v. 161, Jan. 4, '46, p. 5-6.

Lubricating oil filtration; investigation of bearing testing and bearing materials; scuffing of gears; bending fatigue of crankshafts; development and use of electrical methods of measuring strain; influence of leaded fuels on engine life and behavior; deep drawing properties of materials; fundamental studies on plastic stress-strain relationships under combined stress.

25-17. **Carriers and Racks Aid Assembly and Shipping.** John T. Smith. *Production Engineering and Management,* v. 17, Feb. '46, p. 103-104, 106, 139.

Stepped-up mechanical handling method for planned doubled output-schedule of refrigerators; system employs new carriers and racks and revised conveyer lines.

25-18. **Maintenance Progress Through Research.** J. B. Akers. *Railway Age,* v. 120, Feb. 2, '46, p. 281-283.

Much has been accomplished to improve railway tracks and structures, but there is need for further scientific development to improve materials and methods.

25-19. **Industrial Significance of Magnesium's Basic Characteristics.** *Modern Metals,* v. 2, Feb. '46, p. 32-33.

Comments of J. D. Hanawalt before Engineering Society of Detroit about the German magnesium industry; some of the more important magnesium developments which took place during the war in this country.

25-20. **A Metallurgical Study of German Aircraft Engine and Airframe Parts.** *Metallurgia,* v. 33, Jan. '46, p. 125-133.

Object of investigations was to obtain data on the types and quality of materials used, methods of manufacture, efficiency of the heat treatment to which the parts have been submitted, together with any other information which might prove of value, as, for example, details of the finish. Special features concerning design noted. Discusses camshafts, cast components, miscellaneous engine parts.

25-21. **Metallurgical Advances in 1945.** A. G. Arend. *Chemical Age,* v. 54, Jan. 12, '46, p. 67-70.

Spectrographic improvement; micro-radiography; developments with common metals; advancement with rare metals.

25-22. **Metallurgical Progress and the Plastics Industry.** L. Sanderson. *British Plastics,* v. 18, Jan. '46, p. 40-43.

Summarizes new developments in the past year; coating steel; Ihrigizing process; crack detection; rust proofing; phenolic corrosion; deposition of metal; new chromium plating process; new molding press; plastics tubes; plastics rivets; synthetic resins for casting molds.

25-23. **Developments in Ferrous Metallurgy.** C. Sykes. *Metal Treatment,* v. 12, Winter, '46, p. 245-258.

Some of the more outstanding developments that have taken place during the last 20 years in steel quality, trans-

formations and heat treatment, welding, corrosion and scale resistance, and materials having high strength at high temperatures. (Abridged version of the James Forrest Lecture delivered to the Institution of Civil Engineers.)

25-24. **Wartime Materials Developments and the Postwar World.** J. C. DeHaven. *American Society for Testing Materials Bulletin,* no. 138, Jan. '46, p. 17-24.

Gas turbines; casting techniques; forming aluminum sheet for aircraft; new material for dies; applications of magnesium alloys; new uses for glass; plastics and their uses; synthetic rubber; wood; spears into pruning hooks; science and technology—a vital national resource.

25-25. **Modern Distribution Systems for Steel Mills.** W. C. Bloomquist. *Iron and Steel Engineer,* v. 23, Feb. '46, p. 81-84, 101.

Planning and design of a distribution system which is economical and which will provide for future expansion.

25-26. **Lighting Improvements for Steel Plants.** D. H. Tuck. *Iron and Steel Engineer,* v. 23, Feb. '46, p. 95-101.

Fundamental concepts which have resulted in new engineering thinking and specific improvements that have been made in equipment as a result of experience gained during the war.

25-27. **A Steelmaker's Reminiscences and Speculations. Part 2.** *British Steelmaker,* v. 12, Feb. '46, p. 76-78.

Early days of the openhearth processes.

25-28. **Magnesium Dust Control.** Richard V. Sloan. *Western Metals,* v. 4, Feb. '46, p. 44-45.

Dust control equipment and systems; dust producing operations.

25-29. **A Little Can go a Long Way.** Benjamin Melnitsky. *American Machinist,* v. 90, March 14, '46, p. 122-123.

Good order, control and handling system for short ends of bar stock described.

25-30. **The Progress of Magnesium and Its Alloys in Britain 1924-1945.** C. J. P. Ball. *Aluminum and Magnesium,* v. 2, March '46, p. 22-24.

Includes tables on casting alloys and wrought alloys.

25-31. **Applying Fluid Drive in Industry.** G. V. Edmonson. *Iron and Steel Engineer,* v. 23, March '46, p. 73-83, 101.

Applications of fluid drive which have been made in the iron and steel industry. Some of the future possibilities of this method of power transmission.

25-32. **Modern Conveying Systems in Steel Plants.** L. L. Horchitz and Paul W. Van Orden. *Iron and Steel Engineer,* v. 23, March '46, p. 90-101.

Belt conveyers used extensively through Fontana and Geneva steel plants. Discusses their unique features.

25-33. **Postwar Education for Mining Engineers.** Myron Read. *Mining and Metallurgy,* v. 27, March '46, p. 173-174.

Basic engineering training needed to meet problems of management.

25-34. **Bar Stock Records.** Benjamin Melnitsky. *Steel,* v. 118, April 8, '46, p. 95, 126-127, 129, 132.

Simplified inventory control and more effective utilization of stock provided by system described.

25-35. **Oscillating-Trough Conveyer.** *Steel,* v. 118, April 8, '46, p. 113-114.

Conveyer handles sharp, jagged, abrasive, wet, oily or hot metal parts and castings. Oscillation, by eccentric drive, results in maximum forward travel of 50 ft. per min.

25-36. **Handling Equipment Cuts Costs.** Francis A. Westbrook. *Machine Tool Blue Book,* v. 42, April '46, p. 159-162, 164, 166, 168, 170, 172.

Overhead mechanical handling equipment installations of a few outstanding machine tool builders.

25-37. **Atomic Energy and Its Implications.** Cyril Stanley Smith, S. K. Allison, Zay Jeffries, A. B. Kinzel and John Chipman. *Metal Progress,* v. 49, April '46, p. 761-779.

Verbatim report of a round-table discussion at National Metal Congress in February. Physics involved in nuclear reactions; source of uranium; metallurgy of uranium; description of Alamogordo test; future of nuclear power; useful byproducts. The Atomic Energy Act of 1946.

25-38. **Product Output Increased by Conveyer.** Gordon Swadenski. *Production Engineering and Management,* v. 17, April '46, p. 96.

Use of a simple conveyer and feed hopper boosts production 33⅓% on this straddle grind and hot wash operation on track bushings.

25-39. **Conveyer Speeds Sheet Metal Parts Production.** *Iron Age,* v. 157, April 25, '46, p. 55.

Conveyer system for the layout, drilling, and routing operations on sheet metal parts; 22-station intermittently operated conveyer stationizes the various operations at 15-min. intervals by moving 14½ ft. at a speed of 30 ft. per min.

25-40. **Crucible Steel—Early Sheffield Manufacturers.** Archibald Allison. *Iron and Steel,* v. 19, April '46, p. 135-138.

History of the crucible steel industry in England.

25-41. **New Metallurgical Developments Are Revealed at Electrochemical Society Meeting.** Allen G. Gray. *Steel,* v. 118, April 29, '46, p. 108, 113-114, 116.

Cleaning steel; passivation of stainless steel; electric furnace developments; calcium—a scavenger for steel; germanium; ductile zirconium from zircon sand; beryllium; electro-winning of chromium; lead and lead-tin deposits on steel. (Eighty-ninth convention, Electrochemical Society at Birmingham, April 11-13.)

25-42. **The Accuracy of Lumping in an Electric Circuit Representing Heat Flow in Cylindrical and Spherical Bodies.** Victor Paschkis and Michael P. Heisler. *Journal of Applied Physics,* v. 17, April '46, p. 246-254.

Use of lumped resistance-capacitance circuits for studying heat conduction problems. Several methods of lump-

ing are conceivable, and results of comparative tests show that equal geometrical size of lumps is most accurate. In various lumps, resistance and capacitance have to be in certain definite relationships, which are established here.

25-43. **What's Left of Industrial Germany?** Roscoe H. Smith. *Iron and Steel Engineer,* v. 23, April '46, p. 62-66.

Recent inspections made by American industrialists and engineers of German industry have in general exploded the myth that German engineering and science were superior to the American.

25-44. **Power Steel Maker Modernizes Power System.** A. D. Howry and R. H. Wright. *Iron and Steel Engineer,* v. 23, April '46, p. 69-72.

Plant expansions, calling for the addition of equipment to existing power systems, sometimes present a complex problem of economical power distribution. How one steel plant handled the problem is described.

25-45. **Production Efficiency Obtained by Decentralized Operations.** *Production Engineering & Management,* v. 17, May '46, p. 78-88.

Innovations in integrated automatic welding, forging, and machining operations contribute to the efficient manufacture of motor vehicle axle housings.

25-46. **Who Discovered Black-Heart Malleable?** Harry A. Schwartz. *Foundry,* v. 74, May '46, p. 175, 302, 304, 306.

Black-heart malleable iron commonly is assigned 1826 as the year of its origin. The possibility that certain weapons, made of black-heart malleable and found in Minnesota in 1871, are of Norse origin suggests that this form of iron may have existed as much as 600 years ago.

25-47. **Research Organization in the Iron and Steel Industry.** Charles F. Goodeve. *British Steelmaker,* v. 12, May '46, p. 222-225.

The development of the research organization in the industry breaks down into three parts—competitive research in special products, cooperative research, and independent academic research The proper interrelations of these are a matter of considerable importance.

25-48. **The Theory of Vibration.** L. Sanderson. *British Steelmaker,* v. 12, May '46, p. 232-235.

In the operation of forging hammers and similar equipment, the periodic occurrence of an impact shock together with vibration has to be reckoned with. By itself the impact may be harmful to equipment and installations, yet because of the irregularity or infrequency of the shock, and the low or irregular frequency, the ordinary laws of wave motion become inapplicable.

25-49. **The Maintenance of a Steel Wire Mill.** C. B. Tolputt. *Wire Industry,* v. 13, May '46, p. 269-270.

Cause and prevention of breakdowns; broad principles of a maintenance system.

25-50. **Lukens—Pioneer in Steel Plates and Plate Products.** T. J. Ess and T E. Madsen. *Iron and Steel Engineer,* v. 23, May '46, p. L17-L39.

Complete description of plant and facilities of Lukens Steel Co.

25-51. **Conservation of Utilities in Republic's Canton Plant.** P. L. Walter. *Iron and Steel Engineer,* v. 23, May '46, p. 39-50.

Cost of utilities is an appreciable factor in the cost of steel. Reducing the quantity of utilities required merits serious consideration. How this is done in one steel plant is told.

25-52. **Electrical Power Supply for Steel Mill Loads.** F. W. Cramer. *Iron and Steel Engineer,* v. 23, May '46, p. 55-59.

Selection of a power system for a steel plant and the factors on which it is based.

25-53. **Chip Conveyer.** A. H. Allen. *Steel,* v. 118, June 3, '46, p. 123-124.

Installation of 5000-ft. chip conveyer system eliminates nearly all manual handling of automotive borings and turnings.

25-54. **Vibration-Free Foundations.** *Iron and Steel,* v. 19, May '46, p. 192-194.

Specially designed vibration-free foundation for a precision machine tool located on a site of poor bearing quality is described. Method of construction may be applied in other cases where heavy machinery involves high local ground loading.

25-55. **How Timken Keeps the Bearings Rolling. Part 1.** Kenneth R. Adair and C. W. Austin. *Flow,* v. 1, June '46, p. 22-24, 56.

Layout for productive equipment and mechanical handling devices reduces handling because of a shorter travel of work over a succession of adjacent machines or work stations covering cleaning, inspection, assembling, packing, and shipping operations for automotive tapered roller bearings.

25-56. **Ford Adds Speed to Mass Production.** *Flow,* v. 1, June '46, p. 32-35, 62.

Company is revising its material handling procedures (of manufactured stock) in accordance with the "unit load" principle.

25-57. **An Automatic-Robot Shell Manufacturing Plant.** Erik Oberg. *Machinery (London),* v. 68, May 23, '46, p. 649-656.

An automatic mass-production factory where heavy parts weighing in excess of 125 lb. are handled mechanically from the time the billets enter the heating furnaces until the completed shell, after having passed through all machining, heat treating and other operations, is ready for inspection.

25-58. **Vibration Effects Reduced by Flexible Mountings.** S. Rosenzweig. *Industry and Power,* v. 50, June '46, p. 69-71.

Cause of vibration is explained: methods of controlling frequency and intensity are presented and some probable operational gains discussed.

25-59. **Elimination of Vibration in Machine Tools.** Rolland C. Griffith. *Machine Tool Blue Book,* v. 42, June '46, p. 129-132.

General method used in analyzing vibration problems. Examples of actual problems.

25-60. **Standardization of Materials-Handling Equipment.** Nathaniel Warshaw. *Mechanical Engineering,* v. 68, June '46, p. 545-546.

Standardization case for wheels; casters susceptible of standardization; lift-truck system; effect on supplementary equipment.

25-61. **Palletize for Handling.** *Modern Metals,* v. 2, June '46, p. 14-16.

Reviews the problem, gives typical case studies and describes manufacture of aluminum pallets.

25-62. **Science and Life in the World—Celebration of the George Westinghouse Centennial.** *Metal Progress,* v. 49, June '46, p. 1193-1212.

Electric Power, by Charles W. Kellogg; Scientific and Engineering Progress, by Karl T. Compton; Planning in Science, by Vannevar Bush; Horizons in Communications, by Frank B. Jewett; Aviation, a Phase of Transportation, by Edward Warner; The Future of Atomic Energy, by J. Robert Oppenheimer; Nuclear Power, by Enrico Fermi; Radioactive Isotopes for Diagnosis and Cure of Disease, by W. Edward Chamberlain; Isotopes in Chemistry and Metallurgy, by Hugh S. Taylor; Peacetime Implications of Biological Warfare, by George W. Merck; The Social Composition of Scientific Power, by Isaiah Bowman; Ethics of Science, by Archibald V. Hill.

25-63. **Science and the Steel Industry.** C. H. Desch. *British Steelmaker,* v. 12, June '46, p. 298-306.

Modernization of plant needed; services that science can render to the industry; new research association; supply of trained metallurgists; education of technical men; quality of teachers; foreign study; technical developments; economic future. (Extracts from Presidential Address to the Iron and Steel Institute.)

25-64. **Modern Materials-Handling Methods.** Harry S. Wharen. *American Machinist,* v. 90, June 20, '46, p. 109-140.

Hoists, cranes, conveyers, industrial trucks.

25-65. **Industrial Power Trucks Cut Material Handling Costs.** W. A. Lloyd. *Iron Age,* v. 158, July 4, '46, p. 62-66.

Effective use of industrial power trucks for material handling as a means of counteracting current rising wage scales and declining worker productivity. Case histories cover metalworking plants which make a particularly thorough utilization of industrial trucks, and nonmanufacturing operations such as die and machine fixture handling and railroad repair work.

25-66. **Cooperative Research.** Charles Goodeve. *Iron and Steel,* v. 19, June '46, p. 389-391.

Organization in the iron and steel industry.

25-67. **Aluminum Pallet.** T. O. Palmer. *Steel,* v. 119, July 1, '46, p. 125-126.

Saves as much as 80 cents per unit on shipping costs; increases handling flexibility by allowing fork trucks to approach unit load from any angle.

25-68. **Advances in Metallurgy.** W. C. Devereux. *Aircraft Production,* v. 8, July '46, p. 307-309.

Outlines some of the more outstanding wartime achievements in the field of aircraft forgings, castings and extrusions, with particular reference to the gas turbine. Production of impellers required an entirely new type of aluminum alloy forging in sizes in which it had been previously thought impossible to obtain the very exacting mechanical properties required. Touches upon the production of forgings in high-strength light alloy for heavy-duty structural purposes and the development of large hollow steel forgings for undercarriages.

25-69. **Metallurgical Problems.** *Chemical Age,* v. 55, July 6, '46, p. 18-20.

Brief report on research work under way in the National Physical Laboratory of England.

25-70. **Safety in Handling Magnesium.** Norman J. Thompson. *Factory Management and Maintenance,* v. 104, July '46, p. 126-128.

Most hazardous operation is grinding, which requires special separators to remove dust. Molten magnesium also hazardous, moisture must be kept away, and pots must be checked periodically. In machining operations, magnesium is not as combustible as many other materials, but it does require special training of employees and observance of special safeguards. Good housekeeping and prevention of congestion are of prime importance.

25-71. **The Services to Metallurgy of the Late Dr. W. H. Hatfield, F.R.S.** George B. Waterhouse. *British Steelmaker,* v. 12, July '46, p. 350-357.

Professional biography of Dr. Hatfield. Work on steelmaking, cast iron, 18-8 stainless. (Extracts from the first annual Hatfield Memorial Lecture.)

25-72. **Improved Inventory Control.** Benjamin Melnitsky. *Steel,* v. 119, July 29, '46, p 76-77, 113-114, 116, 118.

Planning procedures for bar stock, castings and forgings, and finished parts.

25-73. **Recent Metallurgical Progress. Part I—Developments in Materials.** W. C. Devereux. *Metal Industry,* v. 69, July 12, '46, p. 28-29

Emphasizes that the light alloy fabricating industry must enter many new fields of engineering if it is to maintain its status.

25-74. **Are You Handling Your Cylinders Safely?** *Industry and Welding,* v. 19, July '46, p. 44-45, 62.

Cylinder handling devices considered safe from standpoint of avoiding both personal injury to workmen and damage to cylinders.

25-75. **The Treatment of Waste Waters From the Steel Industry.** Christian L. Siebert. *Iron and Steel Engineer,* v. 23, July '46, p. 78-83.

Acid pickling wastes; plating and heat treatment wastes; blast furnace dust; oil wastes; cutting compounds; phenols.

25-76. **War Development and Steel.** F. Mohler. *Iron and Steel Engineer,* v. 23, July '46, p. 59-66, 77.

Radar; X-ray analyzer; mass spectrometer; mill-type motors; other devices; some peacetime applications.

25-77. **Recent Metallurgical Progress. Part II—Developments in Processes.** W. C. Devereux. *Metal Industry,* v. 69, July 19, '46, p. 54-56.

Developments in continuous casting, precision forging and coining, extrusion, precision casting and new methods of surface finishing are reviewed. Processes applied to aluminum and magnesium alloys are main subjects.

25-78. **New High-Voltage Potential Transformers.** G. Camilli and E. S. Townsend. *General Electric Review,* v. 49, Aug. '46, p. 8-14.

Height, weight, and liquid volume of units are radically reduced by application of new design which is described in detail. Method used for sealing of high and low-voltage glass bushings includes metallizing of porcelain, electrolytic deposition, and a special soldering technique.

25-79. **Some Developments in the Iron and Steel Industry.** A. G. Robiette. *Metal Treatment,* v. 13, Summer '46, p. 99-107, 118.

General trends in the industry; preparation of raw materials; blast furnace developments; bessemer steel; open-hearth practice; electric furnaces; electric smelting and direct reduction; finishing processes—continuous casting, rolling mills, continuous coating; controlled atmospheres; malleable iron; gas carburizing; foundry; induction heating; powder metallurgy; constitution and properties of steel.

25-80. **Pipemaker Starts Large Improvement Program.** John D. Knox *Steel,* v. 119, Aug. 19, '46, p. 132-134, 150, 152.

Works of National Tube Co. at Lorain, Ohio, is being augmented by the installation of new byproduct coke ovens, bessemer plant, soaking pits, blooming, bar, seamless and butt-weld rolling facilities and warehouse. Construction is proceeding without interfering with present operations.

25-81. **Magnesium Production and Fabrication.** *Metal Industry,* v. 69, Aug. 2, '46, p. 91-93.

Extract of report on two plants of I.G. Farbenindustrie, prepared for the Combined Intelligence Objectives Subcommittee. Production; alloys; laboratory; castings; wrought materials; protective coatings; mechanical tests; uses; powder.

25-82. **The Statistical Approach in Industrial Research.** Arthur Lesser. *Iron Age,* v. 158, Aug. 22, '46, p. 50-55.

Based on statistical experiments conducted during the war with regard to quality control and inspection, a procedure is outlined that is equally satisfactory for postwar industrial research. Utilizing data obtained from work conducted in the field of powder metallurgy, the mathematical technique is equally applicable to other phases of the metalworking industry as an important practical tool for analytical purposes. 11 ref.

25-83. **Handling Bar Stock.** Benjamin Melnitsky. *Steel,* v.

Mechanized equipment for moving bars reduces handling time, saves manpower and prevents accidents.

25-84. **A Method for Steel Wire Coils.** *Flow,* v. 1, Sept. '46, p. 44-45, 51.

Use of gravity in conjunction with mechanized equipment speeds the receiving and storing of steel wire coils.

25-85. **Loop-Type Bucket Elevator.** *Steel,* v. 119, Sept. 2, '46, p. 110, 149.

Steel encased, internally loaded, continuous bucket device raises and transports parts that cannot be carried safely by conventional equipment.

25-86. **Copper and Copper-Base Alloys.** J. W. Donaldson. *Metal Industry,* v. 69, Aug. 24, '46, p. 157-160.

Survey of American research on copper and its alloys up to the end of 1945. 27 ref.

25-87. **Conveyers Increase Efficiency of Ford Piston Line.** *American Machinist,* v. 90, Sept. 12, '46, p. 106-109.

Results apparent are: Departmental efficiency has increased 25%; operators approve the change, like the easier rhythm of body movements, are glad to see production mount; supervisor can see trouble at glance because loading of the conveyers is self-evident; nicking of pistons is virtually eliminated.

25-88. **Research Supported by Industry Through Scholarships, Fellowships, and Grants.** Callie Hull and Mary Timms. *Chemical and Engineering News,* v. 24, Sept. 10, '46, p. 2346-2358.

A descriptive list arranged alphabetically according to sponsor. 302 companies report approximately 1800 fellowships, scholarships, or grants.

25-89. **British Labor Views the U.S.S.R. Steel Industry.** *Iron Age,* v. 158, Sept. 12, '46, p. 71A, 71B, 72-76.

Extended abstract of official report of a delegation of the British Iron & Steel Trade Confederation.

25-90. **Novel Assembly Fixture.** Robert Mawson. *Steel,* v. 119, Sept. 16, '46, p. 120, 149.

Fixture enables mechanical operation and low cost on production job consisting of placing a small threaded nut in the molded slot of a plastic cap and then assembling a screw into the tapped hole in the nut.

25-91. **Naval Engineering Duty in Wartime.** Richard Doughton, Jr. *Metal Progress,* v. 50, Sept. '46, p. 455-461.

Vivacious account of duties of engineer officer aboard cruiser operating in Pacific, and the rough-and-ready metallurgy sometimes necessary for emergency repairs, far from base or tender.

25-92. **Control of Vibration.** Alvin W. McKay. *Iron and Steel Engineer,* v. 23, Sept. '46, p. 70-75; discussion p. 75-76.

Importance of high frequency vibration in fatigue of metals with particular reference to heavy machine parts and structures. Practical problems indicate how easily and inexpensively, extensively troublesome vibrations have been successfully reduced in various fields without the use of advanced mathematics or complicated formula.

25-93. **Some New Devices at Alan Wood Steel Co.** J. W. Deimler. *Iron and Steel Engineer,* v. 23, Sept. '46, p. 110-111.

Simple and effective schemes for weighing scrap buggies and for heating tar drums.

25-94. **Maintenance of the Blast Furnace Cooling System.** G. Calder Little. *Iron and Steel Engineer,* v. 23, Sept. '46, p. 112-113; discussion p. 113.

Describes method used for removing scale from blast furnace cooling system pipe line by flushing with inhibited hydrochloric acid.

25-95. **Glycerine in Steel Processing.** Georgia Leffingwell and Milton A. Lesser. *Steel Processing,* v. 32, Sept. '46, p. 579-581.

Combination of physical properties makes this fluid a valuable quenching medium and a useful component of steel cleaning materials, of electropolishing solutions, of foundry molds, and materials employed by steel workers. 22 ref.

25-96. **Marking Aids Identification of Forgings and Finished Parts.** Benjamin Melnitsky. *Steel Processing,* v. 32, Sept. '46, p. 582-584.

When to stamp parts; characters used in marking; method of stamping.

25-97. **Collecting Magnesium Dust, Fume and Chips.** Clarence Carl Hermann. *Aluminum and Magnesium,* v. 2, Sept. '46, p. 14-17, 23-25.

Installation of adequate equipment for the safe control of dust and fumes can completely eliminate these hazards.

25-98. **Aeronca Production.** *Aircraft Production,* v. 8, Sept. '46, p. 436-441.

New plant layout based upon a conveyer system.

25-99. **Training of Metallurgical Engineers in the Steel Industry.** E. C. Wright. *Metals Technology,* v. 13, Sept. '46, T.P. 2051, 10 p.

Recommends that engineering graduates be given about five years of apprentice training in order to develop experienced executive personnel. Program should include periods in analytical, physical testing and metallurgical laboratories, work on specifications and mill control, in report writing, and finally in the research and development laboratory. Summer or cooperative employment of college students, standard apprentice rates, and aptitude testing are suggested.

25-100. **The Story of Nimonic Alloys.** *Aeroplane,* v. 71, Sept. 6, '46, p. 279-282.

The research carried on since 1939 by the Mond Nickel Co. in England, which led to development of suitable alloys for jet engine gas turbine blades. Rolling, forging, melting, and creep testing.

25-101. **Steelworks Layout.** Geo. A. V. Russell. *Iron and Steel,* v. 19, Sept. '46, p. 521-527.

Relationships between the principal operating departments of a works and some of the differences observable in their individual layout. Traffic analyses; material handling. (To be continued.)

25-102. **The National Physical Laboratory at Teddington.** *Nature,* v. 158, Sept. 14, '46, p. 361-363.

Outline of work done. The ten divisions are: aerodynamics, electricity, engineering, light, mathematics, metallurgy, metrology, physics, radio, and ships.

25-103. **Hot, Heavy, and Fast.** *Flow,* v. 2, Oct. '46, p. 42-43.

Continued heats of 1200° F. are a typical production requirement for unwieldy steel rings weighing 800 lb. and measuring up to 7 ft. in diameter. This means fast handling—a difficult job done with ease by fork trucks.

25-104. **Bethlehem Axle Plant Modernized.** R. E. Penrod. *Iron Age,* v. 158, Oct. 10, '46, p. 60-63.

Recent major improvements at the Johnstown axle plant of Bethlehem Steel Co. include a continuous rotary-hearth furnace, gas-fired for controlled cooling of forgings, an axle straightener of novel design and a number of minor auxiliaries.

25-105. **New Fixtures Speed Production at Consolidated Vultee Aircraft Corp.** *Modern Industrial Press,* v. 8, Sept. '46, p. 47-48.

Lightweight indexing fixtures used in connection with automatic riveters, which are extremely efficient and require no special tool design, have greatly reduced tooling costs and speeded airplane assembly operations.

25-106. **Condensed Review of Some Recently Developed Materials.** *Machinery,* v. 53, Oct. '46, p. 171-183.

Such diverse materials as lubricants, welding rod, copper castings, antifog compound, synthetic rubber, plastic adhesive, cleaning solvent, fire resistant chemical ceramic material and many others are listed alphabetically by trade name in a table which includes a column for general description of properties and one for applications.

25-107. **Car Assembly.** *Automobile Engineer,* v. 36, Sept. '46, p. 384-395.

Body manufacture and assembly. Layout has been specially planned to employ the principle of individual schedule issue by sets.

25-108. **British Metallurgical Research Associations.** *Metallurgia,* v. 34, Sept. '46, p. 251-262.

Brief reference is made to metallurgical research work of national and cooperative associations; metallurgical research at the National Physical Laboratory; British Iron and Steel Research Association; British Cast-Iron Research Association; British Non-Ferrous Metals Research Association; British Refractories Research Association.

25-109. **Magnesium.** R. J. Cole. *Discovery,* v. 7, Sept. '46, p. 275-278, 288.

Commercial development, production from sea-water, properties and applications.

25-110. **Codes for Bar Stock.** Benjamin Melnitsky. *Production Engineering & Management,* v. 18, Oct. '46, p. 77-78, 80.

By substituting simple numerical and alphabetical symbols for conventional terminology, size, type, finish and heat treatment can be recorded quickly in a minimum of space. Adoption of codes and the nature of codes must

be based on individual company conditions. Some of the desirable and useful features of codes given.

25-111. **Wartime Advances in Steel Technology.** *Journal of Chemical Education,* v. 23, Oct. '46, p. 470-473.

A short summary of what has been happening to the technology of steel during the war; indicative rather than comprehensive.

25-112. **Battelle Memorial Institute Conducts Extensive Research Related to Steel Plant Operations.** *Blast Furnace and Steel Plant,* v. 34, Oct. '46, p. 1271-1276.

Summaries of the activities of following divisions are presented: Ore Processing and Coal Preparation; Steel Processing; Process Metallurgy; Fuels; Chemical Research; Ceramics; Electrochemistry.

25-113. **Steelworks Layout. (Concluded.)** George A. V. Russell. *Iron and Steel,* v. 19, Oct. '46, p. 555-560.

The materials handling problem in openhearth steel shops; some structural considerations in melting shop layout; the delivery of ingots from steel plants to soaking pits; feeding secondary mills from the primary mills.

25-114. **Coordination of Engineering and Production in the Manufacture of Welded Products.** E. C. Brekelbaum. *Welding Journal,* v. 25, Oct. '46, p. 975-979.

Problems of coordinating engineering designs with the production shop.

25-115. **Invisible Industrial Hazard.** S. Reid Warren, Jr. *Electrical Engineering,* v. 65, Nov. '46, p. 499-507.

Problem of protecting personnel from the effects of X-ray and gamma-ray radiation. Because of "delayed-action" characteristics, safety measures must include not only preliminary protective barrier and distance factors, but must provide for periodic exposure tests and routine measurements of the dose of radiation to which a given worker is subjected. 16 ref.

25-116. **Rugged and Yet so Gentle.** *Flow,* v. 2, Nov. '46, p. 16-18, 38-39.

How costly stainless steel assemblies are handled at the Heil Co., Milwaukee. From the raw material stage to shipping of the milk storage tanks, cranes perform all major handling and transfer operations, including positioning tasks that require considerable skill.

25-117. **The Safe Handling of Solvents.** Lillian Gordon. *Materials & Methods,* v. 24, Oct. '46, p. 905-909.

Proper ventilation and other precautions.

25-118. **Setting up for a New Product.** Lee S. Whitson. *Iron Age,* v. 158, Nov. 7, '46, p. 58-63.

Basic requirements of new product production; quality control; adequate production rates and low manufacturing costs.

25-119. **Metals in Modern Society.** Cyril Stanley Smith. *Mining and Metallurgy,* v. 27, Nov. '46, p. 541-543.

Director of newly organized Institute for the Study of Metals, University of Chicago, reviews the wartime development in metallurgy. He believes that we must do a

great deal more fundamental metal research in the future, in order to continue our advances. Two lines of attack to be followed at Institute for Study of Metals will be low-temperature studies, and the study of deformation mechanisms to aid in the design of metals for high-temperature uses.

25-120. **Canadian Research on Magnesium Alloys.** J. W. Meier. *Canadian Metals & Metallurgical Industries,* v. 9, Oct. '46, p. 20-24.

Activities and services of the Physical Metallurgy Research Laboratories of the Bureau of Mines: experimental foundry; heat treatment; metal forming laboratory; welding laboratory; corrosion prevention laboratory; testing of metal properties.

25-121. **The Metallgesellschaft Research Laboratories. Some Aspects.** G. S. Farnham and R. Potvin. *Canadian Mining and Metallurgical Bulletin,* no. 414, Oct. '46, p. 505-514; discussion p. 515.

Outlines research carried on in the physical metallurgy and chemical research laboratories of Metallgesellschaft in Germany. Among the problems worked on were: corrosion resistance of high-strength aluminum-magnesium-zinc alloys; zinc alloys for various applications; lead bearing alloys; tin substitute alloys; recovery of vanadium from slag; production of alumina from clay; thermic reduction of clay for producing aluminum-silicon alloy and production of magnesium by reduction of dolomite with ferrosilicon under reduced pressure.

25-122. **Transporting Quenching Tanks.** *Steel,* v. 119, Nov. 18, '46, p. 98, 138.

Use of power trucks speeds up production, evens flow of materials and helps to synchronize operations. Homemade truck attachments assist in handling operations.

25-123. **Review of Metal Literature.** Emory C. Skarshaug. *Special Libraries,* v. 37, Nov. '46, p. 294-297.

Describes and comments critically upon A.S.M.'s "Review of Metal Literature", which is printed in the monthly *Metals Review,* and also compiled into an annual volume. Other indexing and abstracting publications, including Battelle's *Library Review,* are also described briefly.

25-124. **Technological Progress Highlighted.** *Steel,* v. 119, Nov. 25, '46, p. 38-40, 113, 114, 116, 119, 122, 124-125.

Digests of technical papers presented at November meeting of American Society for Metals.

25-125. **A Symposium; Plant Layout and Material Handling.** *Tool Engineer,* v. 17, Nov. '46, p. 18-26.

Fitting Factory Layout to the Product, by Andrew W. Kramer, Jr.—Procedure used in studying modest sized operations averaging about 100 direct workers per line of equipment. Plant Layout and Material Handling Studies, by Haylett B. Shaw—Costs reduced by development of equipment that reduces material handling; by employing properly qualified material handling engineers; by design of new buildings around operations; incentive standards.

25-126. **The Place of Research in the Iron and Steel Industry.** *Engineering,* v. 162, Nov. 1, '46, p. 426-427.

Research organization of the British iron and steel industry.

25-127. **Modernizing Malleable Iron Foundries.** Fred A. Pampel. *Foundry,* v. 74, Dec. '46, p. 87-89, 226, 228, 230, 232.
Improved materials handling methods in the foundry.

25-128. **Technology of Zirconium and Titanium and Their Compounds.** Eugene Wainer. *Ceramic Age,* v. 48, Nov. '46, p. 198-201, 215-216.
Occurrence, beneficiation, preparation of derivatives, and commercial applications.

25-129. **Flow Lines and Charts in Factory Planning.** H. M. Harman. *Machinery (London),* v. 69, Oct. 24, '46, p. 525-529.
Various flow charts and lines for different site and product conditions.

25-130. **Improved Handling Repays Initial Cost in 10 Months.** C. Lee Dryden. *Factory Management and Maintenance,* v. 104, Nov. '46, p. 112-115.
Four times the former output per man-hour is achieved through the installation of a conveyer system which moves heavy coils of steel strapping from slitter lines through wrapping operations to shipping platform or storage area. Savings the first year were $24,000.

25-131. **Modern Material Handling Ideas for Cutting Tools.** N. L. Davis. *Iron Age,* v. 158, Dec. 5, '46, p. 68-71.
Booster drives to lengthen chain life and eliminate edge damage in handling steel coils; rubber tread return rollers and higher belt speeds to improve ore handling methods; oscillating trough conveyers for rapid, economical handling of mill scale, machine shop scrap and foundry sands; internal bucket elevators for carrying small parts from a quench.

25-132. **Metallurgy.** *Russian Technical Research News,* v. 1, no. 4, '46, p. 3.
Russian developments in techniques for measuring microhardness applied to study of aluminum-copper and aluminum-silicon solid solution; in composition of bessemer furnace charge for self-fluxing iron sinter; efforts to increase productive capacity of furnaces.

25-133. **A User Looks at Hydraulics.** H. T. Johnson. *Steel,* v. 119, Dec. 16, '46, p. 91, 113-114.
To improve design, installation and operation of equipment, there must be closer cooperation between the manufacturer of hydraulically operated or controlled equipment and his users. Several causes of misunderstanding and difficulties.

25-134. **Ingenious Mechanisms.** *Machinery,* v. 53, Dec. '46, p. 172-174.
Compact table-feeding mechanism; quarter-turn mechanism for transferring sheets from press to oven; an overload relief device for machine protection.

25-135. **Fire-Fighting Trials on Magnesium-Base Alloys.** *Engineering,* v. 162, Nov. 22, '46, p. 481-483, 492.
Magnesium, in several commercial forms, was ignited, and then the fires were put out using several methods.

Results are used to recommend fire-fighting techniques and proper storage of magnesium, and to evaluate the risk involved in common applications of the metal.

25-136. **Fisher Body Devises Aids for Pressed-Metal Handling.** Rupert Le Grand. *American Machinist,* v. 90, Dec. 19, '46, p. 112-115.

Installations at Flint typify skill in development of mechanical substitutes for manual effort. Concerned mostly with mechanical handling aids that Fisher Body has designed and built for its own use.

25-137. **Planning a Plant Layout.** Robert Spurgin, Jr. *Iron Age,* v. 158, Dec. 19, '46, p. 73-75.

Practical procedures for small or large plant layout work.

25-138. **"Merry-Go-Round" System.** *Steel,* v. 119, Dec. 23, '46, p. 59.

Conveyer system used by Willys-Overland to feed jeep front ends to final assembly.

SECTION XXVI

STATISTICS

26-1. 1945 Nickel Deliveries Will Be 25% Below Peak Levels Reached During War Years. Robert C. Stanley. *Metals,* v. 16, Dec. '45, pp. 6-7.

Canada's productive capacity is 320,000,000 lb. annually; largest annual pre-war consumption was 240,000,000 lb. in 1937—refined nickel stocks high due to decline in demand.

26-2. Copper, Lead, Zinc Imports Into U. S. From 1942 to Aug. 1945 Exceeded 5½ Million Tons. Alan M. Bateman. *Metals,* v. 16, Dec. '45, pp. 8-11, 21.

Peacetime needs will also necessitate importation of these metals — country in need of stockpile of strategic metals.

26-3. Zinc Smelting Capacity in United States Was Increased by 37% to Meet War Demand. Myron L. Trilsch. *Metals,* v. 16, Dec. '45, pp. 12-13, 15.

Facilities for producing high grade metal greatly expanded; low grade ores, labor shortage prevented capacity output.

26-4. Russia Recovering. Raymond Arthur Davies. *Iron & Steel,* v. 18, Nov. 30, '45, pp. 525-530.

Great strides are being made towards the restoration and expansion of the Russian steel and engineering industries. Some of the progress already made is reported in detail. Areas devastated by the Germans in their drive to the east are again coming into production.

26-5. Soviet Iron and Steel. I. Bardin. *Iron & Steel,* v. 18, Dec. '45, pp. 657-658.

Immediate aims and objects of the steel industry in the U.S.S.R. are outlined. Implies that the U.S.S.R. aims at becoming self-sufficing so far as the bulk of her needs of ferrous materials is concerned.

26-6. 1945-1946. *Iron Age,* v. 157, Jan. 3, '46, pp. 70-169, 254, 258, 260, 262, 264, 266, 268, 270, 272, 274, 276, 278, 280, 282, 284, 286, 288, 288A-288H, 290, 292, 294.

Annual Review Issue. Steel, by Tom Campbell. Labor, by Lewis B. Schwellenbach. Non-Ferrous Metals, by C. T. Post. What the Public Thinks (a survey of public opinion). Machine Tools, by H. E. Linsley. Consuming Industries, by T. E. Lloyd and S. H. Brams. Stainless Steel, by T. W.

Lippert. Metallurgy, by J. Z. Briggs. Finishing, by Adolph Bregman. Welding, by H. E. Linsley. Foundry, by J. Albin. Ore and Coal, by W. A. Lloyd. Scrap, by John Anthony. Secondary Metals, by W. A. Lloyd. World Production, by John Anthony. Foreign Reconstruction, by Jack R. Hight. Export, by Robert H. Johnston.

26-7. **What Technical Men Expect in 1946.** *Steel,* v. 118, Jan. 7, '46, pp. 262-270, 272, 274, 276-278, 281-282, 284, 286, 289-294, 296, 299, 302, 304, 306-308, 310, 313-314, 316, 318-320, 323-324, 326-328-331-332, 334-336, 338, 341-342, 396, 398, 400-411.

Brief reviews of future practices in iron and steel production; metallurgy; machining; forging, drawing and stamping; lubrication; heat treating; surface treatment; casting; materials handling; joining and welding. In reconversion war-developed techniques will be adapted to peacetime practice and processes will utilize to the fullest characteristics of new or improved metals and alloys. Necessity for holding down costs will foster wider use of efficient new processes and all types of automatic machines, timers and controls. Installation of laboratories and expansion of existing research facilities is indicative of industry's determination to hold its own in either national or international competition.

26-8. **Alloy Steels in War and Peace.** J. W. Donaldson. *Metallurgia,* v. 33, Dec. '45, pp. 79-81.

Broad survey of the activities and achievements of British industry in the alloy steel field is given. Brief reference is made to the conditions imposed upon the steel industry during the war and how difficulties were overcome. While the general character of steel compositions is not likely to change, new low alloy steels developed for wartime use, because of their special military characteristics or because of shortages of alloying elements, will find new uses. Attention is directed to low alloy steels made from alloy steel scrap and to future trends.

26-9. **Britain's Achievements in Light Metals.** *Metallurgia,* v. 33, Dec. '45, pp. 85-86.

Brief review of statistics. Illustrates achievements of Britain's light metals industry during the war period. Quarterly figures from the beginning of 1940 to the middle of 1945, excluding supplies of imported raw and fabricated light metals, show the extent of the achievements made.

26-10. **The Battle of Steel, Part II.** *British Steelmaker,* v. 11, Dec. '45, pp. 542-550.

Second installment of booklet produced for foreign circulation by British Iron and Steel Federation discusses struggle for raw materials.

26-11. **Magnesium Casting Capacity Expands Sharply.** J. C. DeHaven. *Foundry,* v. 74, Jan. '46, pp. 88-91, 206, 208, 210, 212.

Tremendous expansion in capacity for producing magnesium castings was the most obvious wartime development for the industry. Progress in perfecting the technique for casting this metal has important implications for the postwar period.

26-12. The German Cemented Carbide Industry in 1945. Gregory Comstock. *Metal Progress,* v. 49, Jan. '46, pp. 117-121.

Standardized compositions or grades; uses of the various grades; improvements in carbide manufacture; hot pressing of powder.

26-13. German Toolsteel and Special Steel Industry. James P. Gill. *Metal Progress,* v. 49, Jan. '46, pp. 122-124.

Five companies marketed practically all of the toolsteel and special steels that were used in Germany. Striking similarity apparently existed in methods of manufacture in all five companies. All made their product in the form of rolled and forged bars, cold drawn and ground bars, wire, plate, and sheet. Practically all of the steel was melted in electric furnaces yet each of the companies had some openhearth capacity in which carbon and low alloyed steels might be manufactured. Melting practice was quite similar to that used in America. Annealing practice. Gives data on toolsteels manufactured.

26-14. Postwar Prospects for Aluminum Are Bright; New Uses and Markets for Metal Developed. Arthur V. Davis. *Metals,* v. 16, Jan. '46, p. 8-9.

Price lowest in history and downtrend may continue barring inflation and abnormally high labor costs.

26-15. Problem of Lead Supply Will Be Solved Only When OPA Price Ceiling on Metal Is Removed. Irwin H. Cornell. *Metals,* v. 16, Jan. '46, p. 10-11.

Under free market conditions, price would probably not go far above average producers get under government subsidy; metal must maintain its competitive position.

26-16. Slab Zinc Output in 1945 Down 11%; Shipments Declined 7% During Year. Ernest V. Gent. *Metals,* v. 16, Jan. '46, p. 12-14, 22.

Consumption outlook for 1946 promising; average price of all zinc produced in U.S. in 1945 rose to 11.04 cents; imports available to supplement domestic requirements.

26-17. Disparity Between Official U. K. Quotations on Metals and World Prices Expected to End. L. H. Tarring. *Metals,* v. 16, Jan. '46, p. 15-16.

American export price for copper regarded as international value of metal; reopening of London Metal Exchange urged.

26-18. Metal Supply Situation Occasioning Concern; Copper and Lead Output Cut by Utah Strike. *Metals,* v. 16, Jan. '46, p. 17-21.

Shortage of both metals growing; no arrangements yet concluded for supplementing supply by importations.

26-19. German Industry. *Metal Industry,* v. 68, Jan. 11, '46, p. 26-27.

Report on the Vereinigte Aluminiumwerke A. G., Erftwerk, Grevenbroich. Plant had been used for the following major operations: Electrolytic production of aluminum from bauxite; rolling of anti-location strip from the aluminum so produced; recovery of aluminum from swarf and dross; recovery of aluminum from scrap aircraft.

26-20. **Fontana Plant Adds to Steel Finishing Facilities.** *Western Metals,* v. 4, Jan. '46, p. 30-32.

$11,500,000 improvement program will increase volume and variety of products.

26-21. **German Industry Is Taking a Beating.** William J. Hargest. *American Machinist,* v. 90, Feb. 14, '46, p. 113-121.

Estimates that 30% of Germany's industrial capacity has been blasted out of existence. Difficulties in the resumption of industrial operations essential to a minimum economy stem from lack of raw materials, transportation and fuel, as well as unemployment.

26-22. **Progress in British Steel.** Eric N. Simons. *Steel,* v. 118, Feb. 11, '46, p. 90.

Wartime emergency steels and production techniques promise important changes in peacetime steelmaking.

26-23. **Aluminum Progress.** *Light Metal Age,* v. 4, Jan. '46, p. 18.

Report of Aluminum Co. of America on the progress of the industry during the past year.

26-24. **The Battle of Steel.** *British Steelmaker,* v. 12, Jan. '46, p. 30-33.

Discusses transport.

26-25. **Canada Exports Iron Ore.** Louis Doremus Huntoon. *Iron Age,* v. 157, Feb. 21, '46, p. 56-57.

Long an importer of American iron ore, Canada has at last reversed that movement and is now sending its ores into the United States. Over-all picture of Canadian iron deposits is described.

26-26. **Metal Production Figures for 1945.** *Mining Journal,* v. 29, Feb. 15, '46, p. 2-6, 27.

The chronic and serious shortage of labor at the mines was largely responsible for the decline in production of copper, lead, and zinc. The rescinding of Limitation Order L-208 on July 1 had little immediate effect on the gold and silver output in the western states. Arizona continued as the leading copper-producing state, Utah was the principal gold producer, and Idaho ranked first in silver, lead, and zinc production.

26-27. **Problems Posed by Surplus Mines, Mills, and Smelters.** R. H. Ramsey. *Engineering and Mining Journal,* v. 147, Jan. '46, p. 65-70.

No monopoly wanted; report to Congress; plant leasing; how to buy; what is available; cannibalizing plants; future of mining plants; light metals; value of Pidgeon process; chromium and manganese; copper, lead, zinc; iron ore; miscellaneous plants; note to mining; preserve assets.

26-28. **British Steel—Today and Tomorrow.** Eric N. Simons. *Iron and Steel Engineer,* v. 23, Feb. '46, p. 64-66.

Survey of the most important developments in Britain likely to react favorably on postwar production.

26-29. **The Battle of Steel. Record of the British Iron and Steel Industry at War. Part 4. Bricks Without Straw.** *British Steelmaker,* v. 12, Feb. '46, p. 80-90.

General interaction of demand, material, capacity, and the constant need for close coordination of every means of tackling each problem. Rough classification of methods employed to fill war requirements.

26-30. **The Progress of Magnesium and Its Alloys in Britain 1924-1945.** C. J. P. Ball. *Aluminum and Magnesium,* v. 2, Feb. '46, p. 22-25.

The British magnesium industry, how it has grown during the war years and the part it played in helping U. S. develop its production.

26-31. **Steel Outputs.** *Iron and Steel,* v. 19, March '46, p. 102.

Wartime production in Europe and overseas.

26-32. **Metals in Review.** *Engineering and Mining Journal,* v. 147, Feb. '46, p. 71-90.

Review of 1945 production of gold, silver, lead, copper, zinc, tin, cadmium, mercury, beryllium, platinum metals, titanium, bismuth, cobalt, antimony, arsenic, ferro-alloys, chromite, molybdenum, vanadium, ferrosilicon, manganese, nickel, tungsten.

26-33. **Iron and Steel Production.** *British Steelmaker,* v. 12, March '46, p. 116-119.

Wartime figures published for United Kingdom and other countries.

26-34. **The Battle of Steel. Part V and VI.** *British Steelmaker,* v. 12, March '46, p. 128-136.

A record of the British iron and steel industry at war. The human factor; "Mulberries" and houses; piers for use on beaches.

26-35. **No Shortage in Silver but Seeming Scarcity Attributed to Prevailing O.P.A. Price Level.** *Metals,* v. 16, March '46, p. 10-11, 22.

U. S. industrial consumption of silver in 1945 reached new peak of 140,000,000 oz., gain of 12% over 1944.

26-36. **British Copper Consumers Find Supply Very Tight; Ministry Hesitant to Pay 12¢ a Lb.** L. H. Tarring. *Metals,* v. 16, March '46, p. 12-13.

Negotiation for purchase from Chilean producers said to have cooled; concern felt over lead shortage; zinc satisfactory.

26-37. **Tin Position in 1945 and Outlook for '46.** *Metals,* v. 16, March '46, p. 14-16.

Consumption last year was 58,620 tons; 1946 total placed at 65,000 tons; new supply in 1946 may be 42,000 tons.

26-38. **The Future of Iron Ores.** G. A. Hutt. *Enamelist,* v. 23, April '46, p. 13-17.

Present available supplies; statistics on production and depletion; thinning supplies of concern.

26-39. **Control Over Use of Lead Tightened so as to Bring Supply and Demand Into Balance.** *Metals,* v. 16, April '46, p. 8-9, 14.

Second quarter allocations reduced about 10% from first quarter; permissive inventories cut to 30-day supply.

26-40. **Soviet Republic of Kazakhstan Rich in Lead, Copper, Nickel, Antimony and Other Metals.** Dorothy V. Knibb. *Metals,* v. 16, April '46, p. 10-12.

Mining properties being scientifically developed, production steadily increasing and supplies good part of Soviet needs.

26-41. **London Metal Trade Finds Supply of Copper and Lead Tightening With Prices Advancing.** L. H. Tarring. *Metals,* v. 16, April '46, p. 13-14.

Strikes in U. S. metal-producing and consuming industries becloud international situation; U. K. seeks foreign lead.

26-42. **World Survey of Nonferrous Metals.** O. W. Roskill. *Engineering and Mining Journal,* v. 147, March '46, p. 76-81.

Conclusions of this study are that: America (in particular the U. S. A.) will have to maintain a very high level of consumption of the nonferrous metals in the next few years if overproduction is to be avoided; to maintain high levels of consumption, the U. S. A. will be forced to import a much larger quantity of nonferrous metals than formerly; Belgium is likely to emerge as the principal European supplier of nonferrous metals for the continent of Europe; there is unlikely to be much new smelter or refinery capacity for nonferrous metals built in Europe in the next few years except possibly in Belgium for the treatment of zinc ores.

26-43. **U. S. Cannot Produce Enough Lead to Satisfy Home Demand; Return to Free Market Needed.** Clinton H. Crane. *Metals,* v. 16, May '46, p. 6-9.

Free price would make for balance between consumption and production and stimulate importation of foreign metal.

26-44. **Higher Copper Price Needed to Compensate for Increased Costs and Permit Fair Profit.** R. R. Eckert. *Metals,* v. 16, May '46, p. 10-14.

Producers favor extension of emergency price law for nine months and enactment of McFarland amendment raising ceiling prices.

26-45. **Artificially Low Ceiling Kept Production of Copper, Lead, and Zinc at Low Levels.** Julian D. Conover. *Metals,* v. 16, May '46, p. 15-18.

Congressional action needed to assure quick transition to an economy under which United States has prospered.

26-46. **The Light Metals Control.** *Aluminium and the Non-Ferrous Review,* v. 2, Jan-March '46, p. 16.

Achievements of the United Kingdom third and fourth quarters, 1945.

26-47. **Nickel Output Cut by 50% From War Peak to Avoid Accumulating Unwieldy Stocks.** Robert C. Stanley. *Metals,* v. 16, June '46, p. 6-8.

No excess scrap pressing on market; Canadian copper trade faces difficult problems due to United States tariff wall.

26-48. **Lead Shortage Can Be Overcome by Allowing Free Market and Eliminating Import Control.** Felix E. Wormser. *Metals,* v. 16, June '46, p. 9-12.

Our price policy is less realistic than that in United Kingdom; consumers face prospects of higher postwar prices.

26-49. **U. K. Policy of Purchase and Sale of Metals and Control of Prices Cause Controversy.** L. H. Tarring. *Metals,* v. 16, June '46, p. 15-16.

Resumption of open market trading not likely for some time. Consumption of copper shows no great increase.

26-50. **Germany Should Be Banned From Smelting Tin Ores and Scrap as Dangerous War Potential.** P. G. Gueterbock, E. S. Hedges, E. H. Jones, C. Waite, and W. J. Wilcoxson. *Metals,* v. 71, July '46, p. 10-11, 22.

British investigating team finds many facilities to be little damaged; no new techniques believed used.

26-51. **Copper Consumption in the United Kingdom Shows Rise; Certain Shapes Reported Very Short.** L. H. Tarring. *Metals,* v. 8, July '46, p. 15-16.

Fabricators' orders are heavy; lead supply continues to be tight; zinc imports low; tin price rise is expected.

26-52. **Analysis of the Gray Iron Casting Industry.** *Foundry,* v. 74, Aug. '46, p. 96, 214.

Summary of report, "Gray Iron Castings—1945", prepared by the Bureau of the Census, covering the industry's 1945 production.

26-53. **Tin in the Transitional Period.** John W. Barnet. *Department of State Bulletin,* v. 15, Aug. 4, '46, p. 195-196, 238.

Describes work of Combined Tin Committee, an international group, in allocating tin to the various countries. Methods being used to expedite resumption of far eastern tin production; the present supply situation; future prospects.

26-54. **World Copper Outlook.** John E. Kelly. *Mining World,* v. 8, Aug. '46, p. 41.

Opinion in eastern financial and government circles is seen as having reached the conclusion that the United States has become a copper "have not". Internationalist policy makers are using this argument as an excuse for negotiating wholesale barter deals of American manufacturers for foreign ores.

26-55. **The Soviet Union.** *British Steelmaker,* v. 12, Aug. '46, p. 392-397

Survey of the present position and prospects of the Soviet iron and steel industry under the fourth Five Year Plan.

26-56. **United States Must Look to World Markets to Meet Its Growing Shortage of Lead.** William P. McLendon. *Metals,* v. 17, Aug. '46, p. 11-12.

Recent price rise in Great Britain is taken as indication of start of severe price competition.

26-57. **Tight Supply in Antimony Expected to Continue for Balance of Current Year.** *Metals,* v. 17, Aug. '46, p. 13-14.

Imports down due to keener world competition for foreign metal and lack of production in China.

26-58. **London Merchants Believe Metal Prices Approaching Danger Zone; Caution Keyword.** L. H. Tarring. *Metals,* v. 17, Aug. '46, p. 15-16.

Large stocks of scrap metals carried by British Government partly responsible for changing view.

26-59. **Roll-Back of Lead and Zinc Prices Results in Drastic Decline in Available Supplies.** *Metals,* v. 17, Aug. '46, p. 17-21.

Tightness is likely to continue until O.P.A. raises ceilings to bring them in line with world prices.

26-60. **Ore-Reserve Viewpoints.** S. G. Lasky. *Mining and Metallurgy,* v. 27, Sept. '46, p. 466-468.

Five current opinions on the mineral resource position of the United States.

26-61. **An Analysis of the Present Silver Situation.** Richard A. Mozer. *Metal Finishing,* v. 44, Sept. '46, p. 384-385.

Review of silver prices since 1920 and their causes. Analysis is made of the present demand and its distribution in industry. The present silver market is investigated and the future price line noted.

26-62. **U. K. Buys Copper in Chile—Arranges for Refining Scrap Brass in U. S. and Canada.** L. H. Tarring. *Metals,* v. 17, Sept. '46, p. 15-16.

Refined metal to be returned to Britain; purchases in Chile at £10 above ceiling; sharp tin rise expected; lead tight.

26-63. **Iron Ore in Quebec.** *Mining World,* v. 8, Sept. '46, p. 53-54.

A 200 million dollar program is contemplated for development of the vast iron reserves in Quebec and Labrador which are now being explored by Hollinger and M. A. Hanna interests under concession from the Quebec government. If the favorable reports are confirmed, the Quebec-Labrador deposits may take their place among the world's biggest sources of iron.

26-64. **Industrial Development in the Urals.** G. Vorobyov. *Engineers' Digest (American Edition),* v. 3, Sept. '46, p. 458-460.

Brief outline of mines, steel mills, factories, etc., in the region.

26-65. **Magnesium and Magnesium Alloys.** Allen G. Gray. *Steel,* v. 119, Oct. 21, '46, p. 92-96, 112, 115-116.

Fundamental design considerations and applications; background data on the phenomenal development of present production facilities. Tables give properties, yield strength, production data and other statistical data. (First of a series of articles.)

26-66. **Economics of the Engineering Materials—Basic Considerations.** Harold A. Knight. *Materials & Methods,* v. 24, Sept. '46, p. 613-618.

First article of series discusses supply status, trend toward light metals, tendency toward lower costs in "infant industries", performance-cost comparators and tables, and plastics vs. metals.

26-67. **French Iron and Steel.** *Iron and Steel,* v. 19, Oct. '46, p. 564.

Shortage of metallurgical coke still acute. Table gives French steel production figures.

26-68. **Japan—The Rise and Fall of Industrial Development.** *British Steelmaker,* v. 12, Oct. '46, p. 486-487, 489-492.

Development and prewar status of the Japanese steel industry. (Reprinted from the *Monthly Bulletin* of the British Iron and Steel Federation.)

26-69. **Steel Industry Concerned Over Future Supplies of Ore and Coal.** *Steel,* v. 119, Oct. 28, '46, p. 90, 124.

Conservation of low-sulphur coals by blending with high-sulphur grades will assure adequate supply for many years. Enlarged cold rolling facilities may pose future problem in strip industry. Ironmakers beginning to recognize importance of balancing consumption of high-grade iron ores and concentrates. These points brought out in joint meeting of Eastern States Blast Furnace and Coke Oven Association and the Blast Furnace and Coke Association of the Chicago District.

26-70. **The Iron Country a Year After the War.** A. H. Hubbell. *Engineering and Mining Journal,* v. 147, Oct. '46, p. 70-73.

Production of concentrates from taconite is likely within two years. Planned innovations include a stripping technique employing a huge excavater and conveyers. Tests with "fusion-piercing" of blast holes are under way.

26-71. **Ore Reserves and Future Exploration.** Reno H. Sales. *Mining Congress Journal,* v. 32, Oct. '46, p. 30-34.

Program designed to encourage prospecting and the search for undiscovered mineral deposits.

26-72. **Iron Ore Output in United States Down 6% in 1945.** *Skillings Mining Review,* v. 35, Nov. 2, '46, p. 1-2, 4, 15.

Iron ore production, consumption, beneficiation and sintering statistics are given for 1945. These are also broken down state by state, with mention of the individual mines and producers. Four foreign countries are also included.

26-73. **A View of the Future of Metals.** Ernest E. Thum. *Metal Progress,* v. 50, Nov. '46, p. 844-846.

Future prospects with reference to the effect of nuclear power plants, the growing dependence of U. S. on foreign ores, the tendency toward automatic controls in production, the nonferrous metal supply situation, the recovery of aluminum from clay, and development of magnesium for structural uses.

26-74. **Lake Superior Iron Ore Reserves for the Future Operation of the U. S. Iron and Steel Industry.** G. W. Hewitt. *Blast Furnace and Steel Plant,* v. 34, Nov. '46, p. 1383-1392, 1407.

Tables give some of the history of Lake Superior shipment tonnages, grades, analyses, trend of open pit and underground mining, and past story of estimated taxable reserves.

26-75. **Techniques of Soviet Iron and Steel Industry.** I. Bardin. *Metallurgia,* v. 34, Oct. '46, p. 325-326.

Efforts being made to reconstruct the various plants, on the lines of a new five-year plan, which will incorporate more recent developments and enable prewar production to be greatly exceeded. General picture of reconstruction is given.

26-76. **First Half 1947 Steel Demand Estimated at 29 Million Tons.** Gene Hardy. *Iron Age,* v. 158, Nov. 21, '46, p. 106-108.

Civilian Production Administration steel demand estimates. Tonnage demands for carbon and alloy steel, and for pig iron, are broken down into requirements for individual items; for instance, washing machines. These figures are also split into 1st and 2nd quarter estimates.

26-77. **Mineral Raw Materials for Future Security.** O. O. Niegarth. *Metals,* v. 17, Nov. '46, p. 6-8.

Strategic Materials Committee has determined that Government should stockpile critical materials to value of $2,100,000,000.

26-78. **Sees Antimony Consumption in U. S. Growing; Stocks Down to Low Level; Imports Reduced.** James P. Bradley. *Metals,* v. 17, Nov. '46, p. 9-10.

Domestic requirement may reach 46,000 tons annually; stocks held by Government dropped from 23,728 to 5229 tons.

26-79. **United States Faces Continued Shortage of Copper, Lead, Zinc and Tin During the Year 1947.** Arthur R. Maupin. *Metals,* v. 17, Nov. '46, p. 11-14.

Next year's copper supply estimated at 1,000,000 tons; lead needs believed to be 50% greater than supply.

26-80. **Postwar Trends in U. S. Trade—to Midyear 1946.** Grace A. Witherow. *Foreign Commerce Weekly,* v. 25, Dec. 7, '46, p. 6-19.

Extensive export and import statistics, broken down to individual commodities and groups, presented in tables and graphs, together with discussion of future trends.

SECTION XXVII

TECHNICAL BOOKS

of Interest to Metallurgical and Related Fields

27-1. **Modern Organic Finishes, Their Application to Industrial Products.** Rollin H. Wampler. 454 pp., illus., Chemical Publishing Co., Inc., 26 Court St., Brooklyn 2, N. Y. $8.50.

A book of methods. Descriptions of modern finishing materials and equipment for their application, drying and conveying. Main emphasis is on proper selection and proper use of materials and equipment to get the best possible finish at minimum cost.

27-2. **Standard Methods of Analysis of Iron, Steel and Ferro-Alloys.** Third edition, 93 pp., Publications Department, The United Steel Companies, Limited, 17 Westbourne Rd., Sheffield 10, England. 7s, 6d, net.

Advantage has been taken of the progress made in chemical methods of analysis during the past few years to bring the text completely up to date. Confined to standard methods of chemical procedure and does not cover physical methods such as the absorptiometer, the spectrograph and the polarograph.

27-3. **Shop Terms.** Educational Department of International Business Machines Corp., 120 pp., illus., Syracuse University Press, Syracuse, N. Y. $1.00.

A combination dictionary and reference book for industrial workers and office personnel. Includes terms encountered in any manufacturing plant where the usual types of machine tools are operated and mechanical and electrical devices are assembled and inspected.

27-4. **Mechanics for Engineers; Statistics and Dynamics.** Edward Maurer and others. 442 pp., John Wiley & Sons, Inc., 440 Fourth Ave., New York. $4.00.

A text on theoretical mechanics, covering statistics and dynamics; in a third complete re-writing and amplification of "Technical Mechanics" first published in 1903.

27-5. **Fundamental Theory of Servomechanisms.** Leroy A. MacColl. 148 pp., D. Van Nostrand Co., 250 Fourth Ave., New York. $2.25.

An exposition of the mathematics of some kinds of automatic control devices.

27-6. **Network Analysis and Feedback Amplifier Design.** Hendrik W. Bode. 551 pp., D. Van Nostrand Co., 250 Fourth Ave., New York. $7.50.

Basic circuit theory and mathematical analysis of feedback amplifiers. Practical circuit considerations and conclusions. Stress is laid on interpretation of circuit behavior from graphs of circuit functions.

27-7. **Atomic Artillery and the Atomic Bomb.** John Kellock Robertson. 193 pp., illus., D. Van Nostrand Co., 250 Fourth Ave., New York. $2.50.

A non-mathematical explanation of recent developments in atomic science; a revision of "Atomic Artillery," published in 1937.

27-8. **Centerless Grinding.** 103 pp., Arthur Scrivener, Ltd., Tyburn Rd., Birmingham. Gratis.

Principles involved in centerless grinding, broad classes of work for which process is suitable, surface finish, and the limits of accuracy which can be obtained as a commercial proposition. Design of centerless machines and their equipment. Examples of actual work ground on such machines.

27-9. **Canadian Mines Handbook 1945.** 320 pp., Northern Miner Press, Ltd., 122 Richmond St., West, Toronto, Canada. $1.00.

Lists 7100 mining companies and syndicates organized in Canada. Position of operating companies reviewed with five-year comparisons of output, earnings and other essential information.

27-10. **Engineering Materials.** A. H. White. 547 pp., National Industrial Publishing Co., 1400 Union Trust Bldg., Pittsburgh, Pa. $4.50.

Plastics, protective coatings, corrosion, water softening, and newer alloys, as well as older types of ferrous and non-ferrous metals, clay products, cement, and concrete. Treatment stresses relationship of properties of materials to their atomic and crystalline structure.

27-11. **Basic Electrical Engineering; Circuits, Machines, Electronics.** A. E. Fitzgerald. 452 pp., illus., McGraw-Hill Book Co., 330 W. 42nd St., New York. $3.75.

Basic principles of the fields of electronics, measurements and control, with emphasis on their engineering and other practical applications.

27-12. **Applied Energy Conversion; a Text in Power Plant Engineering.** Bernhardt G. A. Skrotzki and William A. Vopat. 522 pp., illus., McGraw-Hill Book Co., 330 W. 42nd St., New York. $5.00.

An explanation of the functions and operating principles of the major equipment used commercially in the conversion of energy and of a central station and industrial plant.

27-13. **Marine Engineers' Handbook.** John Madison Labberton, ed. 2031 pp., diagrs., McGraw-Hill Book Co., 330 W. 42nd St., New York. $7.50.

A complete revision based on Sterling's "Marine Engineers' Handbook," with engineering fundamentals reprinted from Mark's "Mechanical Engineers' Handbook."

27-14. **American Machinists' Handbook and Dictionary of Shop Terms.** Fred Herbert Colvin and Frank Arthur Stanley. 8th edition, 1567 pp., illus., McGraw-Hill Book Co., 330 W. 42nd St., New York. $5.00.

The sections on Whitworth threads, wire measurement of screw threads, milling practice, bevel and other gearing have been much changed.

27-15. **Electronics Dictionary.** Nelson Magor Cooke and John Markus. 441 pp., illus., McGraw-Hill Book Co., 330 W. 42nd St., New York. $5.00.

An illustrated glossary of over 6,000 terms used in radio, television, industrial electronics, communications, etc.

27-16. **Negative Rake Cutting.** 68 pp., Alfred Herbert, Ltd., Coventry, England. 2s. 6d.

Study of chip formation, and reasons for the use of tools with negative rake. Various factors governing power required, feeds and speeds, depth of cut, rake angle and shape of tool are dealt with in detail, some useful tables being included.

27-17. **Simplified Practice Recommendation No. R212-45.** Superintendent of Documents, Government Printing Office, Washington 25, D. C. 5 cents each; 25% discount on orders of 100 or more.

Provides a stock list of cast brass solder-joint fittings. Thirty-seven types of fittings are illustrated as well as complete data on sizes of the various types.

27-18. **An Introduction to X-Ray Metallography.** A. Taylor. 400 pp., illus., Chapman & Hall, Ltd., 37 Essex St., London W.C.2, England. 36s. net.

A long chapter on "A Study of Thermal Equilibrium Diagrams by X-Ray Methods" describes underlying theory of phase diagrams and examines X-ray diffraction techniques for complimenting thermal and microscopic methods. Also discusses space lattice, experimental methods of obtaining patterns, influence of atomic pattern on intensities of reflections, crystal structures of metals, grain orientation, and application of X-rays to study of refractories. X-ray technique is placed in its proper perspective as being complimentary to thermal and microscopic methods for establishing equilibrium diagrams.

27-19. **A Dictionary of Metallography.** R. T. Rolfe. Chapman & Hall, Ltd., 37 Essex Street, London, W.C.2, England. 15s. net.

Definitions cover various aspects of atomic structure, chemical elements, metallic structure, mechanical testing, and industrial forming, joining and heat treatment operations.

27-20. **Tinplate.** W. E. Hoare and E. S. Hedges. 292 pp., illus., Edward Arnold, London. Price 40s. net.

A balanced account of the history, manufacture, uses, properties, structure, testing and corrosion resistance of

tinplate, in such a form as to be of equal service to both manufacturers and users. Tinplate fabrication is omitted.

27-21. **Physical Structure of Alloys; an Introduction to Modern Physicochemical Theories.** C. E. Beynon. 126 pp., Edward Arnold, London, England. 6s. 6d.

Simplified account of modern theories of metal and alloy structure.

27-22. **Sequential Analysis of Statistical Data—Applications.** 300 p., Columbia University Press, 2960 Broadway, New York 27, N. Y. $6.25.

Use of the sequential method in the routine inspection of products whose quality is measured along a scale and of products whose units are rated good or bad; in the comparison of two experimental processes or two production processes; in general experimental and development work.

27-23. **Peele's Mining Engineers' Handbook. Third Edition.** Edited by Robert Peele and John A. Church. Two volumes, 2242 p., John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $15 per set.

Section on methods of mining revised; new section on petroleum production included; also new section on geophysical prospecting; section on mine ventilation rewritten; section on underground handling and conveying of minerals expanded.

27-24. **Inspection Handbook for Manual Metal-Arc Welding.** 156 p., American Welding Society, 33 West 39th St., New York 18, N. Y. $1.50.

Requirements and duties of a welding inspector; methods of testing welds; comprehensive description of weld inspection by visual, magnetic particle, and radiographic methods. One section discusses principal types of weld defects and how they may be detected and corrected.

27-25. **Hammerscale.** Gordon S. Altman. 116 p., illus., Erie Foundry Co., Erie, Pa.

Informal story of a typical American company making forge shop machinery during its first 50 years of operation.

27-26. **Raw Materials From the Sea.** E. Frankland Armstrong and L. Mackenzie Miall. 164 p., illus., Constructive Publications, Ltd., 213 London Rd., Leicester, England. 15 s. net.

Chemicals in the sea; the biochemistry of the oceans; solar salt; bromine from the sea; magnesium from the sea; iodine and the seaweed industry; potassium salts; potable water from sea water. A general account of the winning of substances from the sea and the chemical problems which the oceans represent.

27-27. **Electroplating on Aluminum and Its Alloys.** 30 p., Aluminum Co. of America, Pittsburgh, Pa. Gratis.

Phosphoric acid anodic process and the zinc immersion process. Specific details of racking, cleaning, rinsing, anoding, coating technique, plating, equipment, agitation are given for the phosphoric acid anodic process. Production setup technique is completely described for the zinc immersion process.

27-28. **Lubricating and Allied Oils.** Elliott A. Evans. Third Edition. 210 p., Chapman and Hall, Ltd., 11 Henrietta St., London, W.C.2, England.

Present state of knowledge of boundary and film lubrication is summarized, and the important subject of viscosity is well covered. Two chapters which should appeal particularly to the engineer are "Selection of Lubricants" and "Oils Employed"; the latter includes information on cutting and quenching oils.

27-29. **The Efficient Use of Fuel.** 800 p., illus., His Majesty's Stationery Office, England, or Chemical Publishing Co., 26 Court St., Brooklyn 2, N. Y. $8.50.

Coal and its derivatives, such as coke, retort gas, producer gas, blast furnace gas, water gas, coal tar, and their utilization. Deals solely with British coals and their derivatives and gives viscosity data in "Stoker" units. England's industry and heat economy are based on coal; natural gas is not available, and comparatively little fuel oil is used.

27-30. **Handbook of Material Trade Names.** O. T. Zimmerman and Irvin Lavine. 503 p., Industrial Branch Service, Dover, N. H.

A compilation of over 5000 trade-named materials, giving names, properties, uses, and names and addresses of the manufacturers or distributors.

27-31. **Die-Casting Dies, Design and Operation.** H. K. Barton and L. C. Barton. Machinery Publishing Co., 17 Marine Parade, Brighton, England.

Various chapters cover die blocks and core blocks; the use of ejectors; simple core mechanisms; disposition of the die cavity; location of inserts, sprues, runners, and gates; venting of dies; and screw threaded components.

27-32. **Wear of Metals.** D. Landau. Second Edition. 85 p., The Nitralloy Corp., 230 Park Avenue, New York 17, N. Y.

A discussion of the mechanism of wear phenomena and influencing factors. Bibliography of 66 references.

27-33. **Steel in the War.** Douglas A. Fisher. United States Steel Corp., 71 Broadway, New York 6, N. Y. Gratis.

Some of the industrial feats performed by the steel industry during the war in producing steel for ships, guns, bombs and shells, planes, tanks, transportation and supply, and for our Allies. Statistical summary included.

27-34. **Opportunities for Productive Work Through Mineral Industries Research.** Circular 20, 36 p., illus., Mineral Industries Experiment Station, The Pennsylvania State College, State College, Pa., Gratis.

Importance of the mineral industries; scope of the School of Mineral Industries; objectives and organization of the Experiment Station; research program.

27-35. **Recommended Practices for Resistance Welding.** 47 p., American Welding Society, 33 West 39th St., New York 18, N. Y. $0.50.

Recommended practices for the spot and seam welding of low carbon, stainless and hardenable steels, nickel,

monel and inconel; projection welding of low carbon and stainless steels; flash-butt welding of low and medium forging strength steels; and standard methods for testing resistance welds.

27-36. **Process Control of Aluminum Foundry Procedure.** Special Publications Department, Society of Automotive Engineers, Inc., 29 West 39th St., New York 18, N. Y. $2.50.

Prepared by the Aluminum Castings Committee of the S.A.E. War Engineering Board. A compilation of recommendations on how to interpret castings, how to control methods of making castings, and what pitfalls to avoid in foundry practice.

27-37. **Emulsion Technology, Theoretical and Applied — a Symposium.** Revised and enlarged. 377 p., Chemical Publishing Co., Inc., 26 Court St., Dept. JF, Brooklyn 2, N. Y. $6.50.

Theory of emulsions; comprehensive list of emulsifying agents; methods of formulation of many practical, commercial emulsions in various fields including paints, photography, rubber, waxes; patent literature.

27-38. **Rubber in Engineering.** 304 p., illus., Chemical Publishing Co., Inc., 26 Court St., Dept. JF, Brooklyn 2, N. Y. $5.50.

A book for the engineer who uses rubber parts in designing or manufacturing machinery. Prepared under the direction of the controller of chemical research of the Ministry of Supply and the directors of scientific research of the Ministry of Aircraft Production and the Admiralty.

27-39. **German for the Scientist.** Peter F. Wiener. 250 p., Chemical Publishing Co., Inc., 26 Court St., Dept. JF, Brooklyn 2, N. Y. $3.50.

Elements of scientific German. Part I gives a brief summary of the grammatical and constructional difficulties; parts II and III embrace passages in German taken from chemistry and physics literature and containing basic words occurring in scientific German, and Part IV includes the complete but not always literal translation of the passages in Parts II and III. A vocabulary is included.

27-40. **Engineering Practice. v. 1.** Henry Hirst. 158 p., published in Melbourne, Australia.

Information has been abstracted from recent articles in technical magazines and proceedings of scientific societies, supplemented by the author's own broad experiences as a metallurgist. Includes many tables of physical properties. Bibliography.

27-41. **Kingzett's Chemical Encyclopaedia.** Seventh edition, revised and edited by Ralph K. Strong. 1092 p., Bailliére, Tindall and Cox, London.

Principal metals are dealt with mainly from a chemistry angle, but under "iron" reference is made to steel, the iron-carbon equilibrium diagram, etc. Production figures given are for 1936 and references are, generally, 12 to 14 years old.

27-42. **Steel and Its Practical Applications.** Second edition. William Barr and A. J. K. Honeyman. Blackie and Son, Ltd., London and Glasgow.

The section on heat treatment has been brought up to date, and the principles involved are dealt with in a lucid manner; practical details of industrial heat treatment are included. The section on alloy steels has been brought up to date by the inclusion of the emergency wartime alloy steels. Weldability and surface hardening are discussed, the latter chapter covering all aspects of the subject, such as gas carburizing, pack carburizing, nitriding, and case hardening. Flame hardening and induction hardening are mentioned briefly.

27-43. **The Application of Radiant Heat to Metal Finishing.** Second edition, revised. J. H. Nelson and H. Silman. Chapman and Hall, Ltd., 37, Essex St., London, W. C. 2, England.

Advantages of electric dull emitter element described.

27-44. **Polarographic and Spectrographic Analysis of High Purity Zinc and Zinc Alloys for Die Casting.** His Majesty's Stationery Office, London.

In four sections: (1) Polarographic analysis of high purity zinc and zinc alloys for die casting, by A. S. Nickelson and J. B. Randles. Methods are given for the determination of iron and copper and of lead, tin, and cadmium. (2) Spectrographic determination of the alloying constituents, aluminum, copper, and magnesium, in zinc alloys for die casting, by B. D. Darrah, J. A. C. McClelland, and D. M. Smith. Spark methods using alloy rods have been successfully developed. (3) Spectrographic determination of impurities in high purity zinc and zinc alloys for die casting by the intermittent a.c. arc technique, by G. W. Kingsbury and J. A. C. McClelland. An accurate method for lead, tin, cadmium, iron and copper was developed. (4) Spectrographic analysis of high purity zinc and zinc alloys for die casting by the oxide arc method, by A. S. Nickelson and A. L. Stubbs. Painstaking investigation was made of the conditions for sensitivity and reproducibility when arcing between graphite rods, the lower of which had a depression containing some of the sample reduced to a powdered oxide.

27-45. **Negative Rake Milling.** 60 p., The Machinery Publishing Co., Ltd., 17, Marine Parade, Brighton, England.

Results of practical tests with various angles of rake and extremes of speeds and feeds are given, together with examples of cutter design and recommendations on the suitability of machine tools. Comparison is made between cutters with positive and negative rake employed on similar work, and figures for power consumption are stated. Examples are included of milling set-ups which have given outstanding results.

27-46. **Diamond Tools.** Paul Grodzinski. 392 p., N.A.G. Press, Ltd., 226, Latymer Court, Hammersmith, W.6, London, England.

Deals solely with their uses; includes diamonds used as cutting tools, as means for dressing abrasive wheels and the employment of diamond dust as an abrasive material.

27-47. **Electron Optics and the Electron Microscope.** Vladimir Kosma Zworykin and others. 777 p., John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $10.

A comprehensive survey of the nature and purpose of the electron microscope for the microscopist and for the optical designer.

27-48. **The Welding of Cast Iron by the Oxy-Acetylene Process.** Second edition. L. Tibbenham. 120 p., Sir Isaac Pitman & Sons, Ltd., Parker St., Kingsway, London W.C.2, England.

Properties of plain and alloy cast irons, and methods of preparation and welding of castings. Discusses the various fuel gases, of which acetylene is the principal, and describes the low and high pressure systems and the equipment required. Various welding rods dealt with briefly.

27-49. **Welding Manual.** 168 p., Quasi-Arc Co., Ltd., Bilston, Staffordshire, England.

Well-illustrated instructions on the welding of mild steel and other materials. Welding shop equipment and data tables for use by the drawing office.

27-50. **Cold Working of Brass.** L. E. Gibbs. 112 p., illus., American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio. $2.00.

Special emphasis placed on 70-30 cartridge brass. While the book touches on the problems arising in the brass mill, it is mostly concerned with the troubles that may arise in the consumer's plant and that may be cured by a slight change in the treatment of the metal. Confined more to metallurgical problems than to mechanical. Chapters on hardness and grain size, effect of cold working and annealing, of minor changes in chemical composition, testing and inspection, typical manufacturing problems, cause and cure of season cracking.

27-51. **Induction Heating.** 172 p., illus., American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio. $3.00.

A series of five educational lectures presented at the Feb. 1946 National Metal Congress. Induction heating considered from a standpoint of principles and theory, induction circuits and frequency generation, practical applications and comparison with other heating and hardening methods.

27-52. **Magnesium.** 266 p., illus., American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio. $3.50.

A series of five educational lectures presented at the Feb. 1946 National Metal Congress. American reduction practice for magnesium; structural design (weight-saving possibilities, allowable working stresses, and comparisons with other structural metals); magnesium castings; wrought alloys and fabrication and joining methods; corrosion and protection of magnesium.

27-53. **Corrosion of Metals.** 192 p., illus., American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio. $3.00.

A series of five educational lectures presented at the Feb. 1946 National Metal Congress. Basic principles of

corrosion; effect of composition and environment on corrosion of iron and steel; stainless steels and the high nickel alloys; the light metals aluminum and magnesium; corrosion behavior of the copper alloys.

27-54. **Metallic Corrosion, Passivity and Protection.** Ulick R. Evans. 830 p., Longmans-Green & Co., Inc., 55 Fifth Ave., New York 3, N. Y. $13.50.

Thorough study of the effects of electrochemical action, thin films, oxidation, moisture, nonoxidizing corrosion, stress, contacts and crevices, water inhibition, chemical treatment, paints and enamels, metallic coatings, and tests.

27-55. **Gas in Light Alloys.** L. W. Eastwood. 84 p., John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $2.50.

Practical problems of melting light alloys.

27-56. **Metal Industry Handbook and Directory.** 1945. 476 p., The Louis Cassier Co., Ltd., Dorset House, Stamford St., London, S.E. 1, England.

Includes extensive revisions of the sections on the properties of the principal metals and some of the rarer metals, of the official British specification for nonferrous alloys, and of the proprietary alloys section. Hardness conversion table for use on brass has been added.

27-57. **The Metallurgy of Steel Castings.** Charles W. Briggs. 633 p., illus., McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 18, N. Y. $6.50.

Detailed information on technical and metallurgical control in the production of steel castings presented so as to be understandable to operating men, apprentices, buyers, design engineers, and students. Basic and acid practice; gases, deoxidation, porosity and inclusions; tapping and pouring; contraction and fluidity; solidification; gates and risers; molding sands and cores; casting defects; cleaning, chipping and grinding; heat treatment and metallography; welding; inspection and properties.

27-58. **Instruction Programs, DoAll Machine Tools and Gages. Volume 1. Sawing Machines—Precision Sawing and Filing Methods.** 263 p., illus., DoAll Co., 1301 Washington Ave., South, Minneapolis 4, Minn. Free on request on company letterhead.

Instructional material covering contour sawing and filing, applications and operational techniques for all types of materials. One section covers conventional and another high-speed sawing procedures.

27-59. **The Basis of Sheet Metal Drafting.** W. H. Hedley. Longmans-Green and Co., Ltd., 43 Albertdrive, London, S.W. 19, England.

Intended primarily for technical school students taking the first-year senior course in sheet metal work; deals with the elements of geometrical and calculation methods of pattern development for sheet metal articles.

27-60. **Tinplate.** W. E. Hoare and E. S. Hedges. 292 p., Longmans-Green & Co., 55 Fifth Ave., New York 3, N. Y. $12.00.

History and processes of tinplating, hot and cold rolling, pickling, annealing, tinning, coatings, testing, corrosion, and electroplating.

27-61. **Practical Designs for Drilling, Milling, and Tapping Tools.** C. W. Hinman. 405 p., McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. $4.50.

Practical manual on the computing, drafting, and designing of drilling jigs, gages, hand tools, tapping and milling fixtures. Book emphasizes those principles that can be applied in the greatest number of designing problems, illustrates their application, and includes drafting suggestions, shop mathematics, short-cut formulas, and other information invaluable to the machine shop designer.

27-62. **Finishing Metal Products.** Herbert R. Simonds and Adolph Bregman. 337 p., McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. $4.00.

Covers not only the technique involved in metal finishing, including such processes as cleaning and descaling, but also the commercial aspects, the sales value of attractive finishes, the effect of color, etc.

27-63. **Handbook for Electric Welders.** Revised Edition. Murex Welding Processes, Ltd., Waltham Cross, Hertfordshire, England.

Electrical theory of arc welding; choice of equipment; physics of the electric arc; electrodes; welding of special materials, including cast iron, stainless steels and nonferrous metals and alloys; strength of welded joints; mechanical testing.

27-64. **Simplified Punch and Die Making.** James Walker and Carl C. Taylor. 235 p., MacMillan Co., 60 Fifth Ave., New York 11, N. Y $5.75.

Guide on the design, construction, and operation of all types of punches and dies. No obsolete methods included. Every tool described has been actually constructed and proved successful in use.

27-65. **Hoyer-Kreuter Technological Dictionary.** Alfred Schlomann. 3 volumes, 2462 p., Frederick Ungar Publishing Co., 105 E. 24th St., New York 10, N. Y. $50.00.

Vol. I: German, English, French; Vol. II: English, French, German; Vol. III: French, German, English. This dictionary is most thorough and covers the terms used in crafts and industries, engineering, raw and finished materials, material testing, semifinished and finished products, electrical and communication engineering, metrology, cinematograph engineering, ordnance, optical, medical and sanitary engineering, safety engineering, and chemical technology, agriculture and forestry, foodstuffs, textiles and clothing industries, shipbuilding and navigation, patents, law and customs, and many other fields of engineering and commercial activity.

27-66. **Metal Working and Heat Treatment Manual. Volume 1.** F. Johnson. 204 p., Paul Elek, Ltd., Diamond House, 36-38, Hatton Garden, London, E. C. 1. 17s. 6d. net.

Deals exclusively with carbon steels. Influence of composition and treatment on the structure and properties of

steel is first dealt with, followed by chapters on practical operations and hardenability. Mechanical testing is covered and supplementary notes on heat treatment operations are included. Composition and properties of American Standard, British Standard and D. T. D. steel specifications are set out in an appendix.

27-67. **Industrial Research.** E. N. da C. Andrade. Todd Publishing Co., Ltd., London and New York; British distributors Geo. G. Harrap & Co., Ltd., 182 High Holborn, London, W. C. 1.

27-68. **Recommended Practices for Automotive Flash-Butt Welding.** 22 p., American Welding Society, 33 West 39th St., New York 18, N. Y. 30 cents.

Based on a survey of flash-butt welding as used by the automobile industry. Included are sections on automotive type steels, flash welding equipment, design considerations, tooling, welding technique, and inspection.

27-69. **Audel's Welders Guide.** Frank Duncan Graham. 422 p., 40 diagrams. Theo Audel & Co., New York. $1.00.

27-70. **Electronics in Industry.** George M. Chute. 461 p., illus., McGraw-Hill Book Co., 330 West 42nd St., New York 18, N. Y. $5.00.

Describes and explains a wide variety of electronic equipment used in industry for the man with little technical training. Explains vacuum tubes and complete tubes working in proven circuits. Circuits are traced in terms of electron flow instead of the conventional current flow and new standardized symbols are followed.

27-71. **Principles and Practice of Heat Treatment.** J. Winning. Emmott & Co., Ltd., 31, King Street West, Manchester, and 21, Bedford Street, Strand, London, W. C. 2.

27-72. **Optical Instruments in Engineering.** Sidney H. Hemsley. Paul Elek, Ltd. Diamond House, 36-38 Hatton Garden, London, E. C. I., England. $2.00.

Optical principles, including light rays, refraction, opaque substances, lenses, determination of focal length of lens; a brief outline of optical instruments used in engineering; measurements of errors of alignment and inclination; optical methods in fine measurement; use of optical interference and ultra-optical methods.

27-73. **Materials Handling Equipment.** Matthew W. Potts. 172 p., Pitman Publishing Corp., 2 W. 45th St., New York 19, N. Y. $2.50.

Defines and describes general applications of essential and more widely used types of materials handling equipment.

27-74. **Changing the Shape of Metals With an Engine Lathe.** 160 p., Shell Oil Co., Inc., 50 W. 50th St., New York, N. Y. $7.50.

Not a textbook, but intended to supplement existing training programs. Explains why the lathe operates as it does, and shows the precise functioning of the various parts.

27-75. **Foundry Sand and Mold Materials, Report Number Two, prepared by the Northern California chapter, A.F.A.**

164 p., American Foundrymen's Association, 222 W. Adams St., Chicago 6, Ill. $2.00.

Core mixtures, wet blacking, facing mixtures, and washes which are being used in various foundries; techniques of measuring and mixing materials; methods of production, characteristics and adaptability of new local sands; casting defects traceable to sand characteristics and practices; porosities of sands; binders; countless details which must be observed in successful foundry practice.

27-76. **Process Control and Repair of Ferrous Castings.** 145 p., Special Publications Department, Society of Automotive Engineers, 29 W. 39th St., New York 18, N. Y. $3.00.

A compilation of six reports requested by the Army Ordnance Department. Recommended procedures for melting processes, molding, cleaning, heat treating and material specifications; general outline of the pitfalls that threaten the foundryman; important factors and limitations of the various repair methods. Extensive bibliography; 20 pages of tables, charts, photographs and drawings.

27-77. **Principles of Field and Mining Geology.** J. Donald Forrester. 647 p., illus., John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $7.00.

Gives students and mining operators the complete picture of a field venture in the mineral industries. Covers recognition of geologic phenomena; general field survey practices and procedures; special field techniques of mining geology; interpretation and use of field data.

27-78. **Standard Code for Arc and Gas Welding in Building Construction.** 68 p., American Welding Society, 33 West 39th St., New York 18, N. Y. $0.50.

New edition embodies revisions based on experience in recent applications of welding to structural fabrication; section on design provides for increased allowable weld unit stresses; sections on filler metal, workmanship, inspection and qualification of welding operators and procedures have been revised.

27-79. **Designing With Magnesium.** 323 p., illus., diagr., American Magnesium Corp., 2210 Harvard Ave., Cleveland, Ohio. Free.

When and why to specify magnesium; weight saving with magnesium; choice of fabrication; tensile properties; stiffness and modulus of elasticity; compressive properties; strength in bending; shear and torsional strength; hardness and resistance to wear; resilience, toughness and notch impact strength; resistance to fatigue; damping capacity, vibration and acoustic properties; dimensional changes in service; high and low temperature properties; thermal properties; electrical and magnetic properties; resistance to corrosion; forming; machining; joining; selection of allowable design stresses; casting design; forging design; structural design; tables, references and index.

27-80. **Involutometry and Trigonometry.** Werner F. Vogel. 321 p., Michigan Tool Co., Detroit, Mich. $20.00.

Numerical tables intended to simplify engineering calculations related to the design and manufacture of products based on involute curves and surfaces, such as gears, gear

tools, splines. Various involute curves and surfaces are classified, their geometrical properties described, and basic calculations related to them given. Tables af derivatives, integrals of involumetry and graphical characteristics are included for ready reference. Involute tracing tables; new tables of gear formulas.

27-81. **Photography in Engineering.** C. H. S. Tupholme. 276 p., illus., Faber and Faber, Ltd., 24 Russell Square, London, W.C. 1, England, and the Hyperion Press Ltd. $7.50.

Presentation in convenient form of those photographic techniques which have proved of value in assisting the engineer. Eight classifications include specific applications selected as typical and adaptable to variation. Photography of drawings and documents; photography in the laboratory; high-speed photography; radiography; X-ray and electron diffraction and microradiography; processing and storing X-ray material; infrared photography; instructional motion pictures.

27-82. **The Heat Treatment of Steel.** Edwin Gregory and Eric N. Simons. 358 p., illus., Sir Isaac Pitman & Sons, Ltd., Parker St., Kingsway, London, W.C. 2, England. 18 s.

Simple instruction and exposition in regard to heat treatment. Complex laws and processes reduced to simple and clear statements suitable for both laymen and engineer.

27-83. **The Metallurgy of Quality Steels.** Charles M. Parker. 248 p., illus., Reinhold Publishing Corp., 330 W. 42nd St., New York, N. Y. $6.00.

Based largely on educational lectures given before American Society for Metals, New York Chapter, and Army Air Force School of Inspectors. Sticks close to fundamentals, although some of the ideas are controversial. Covers manufacture, ingot practice, rolling, inspection and testing, critical points, heat treatment, alloying, hardenability, special and general characteristics.

27-84. **A Chronological History of Electrical Development From 600 B.C.** 143 p., National Electrical Manufacturers Association, 155 E. 44th St., New York 17, N. Y. $2.00.

Chronology of basic data from which have stemmed many other electrical developments and uses. Covers from 600 B.C. to 1944. Appendix lists member companies of National Electrical Manufacturing Association with historical data concerning each company. Extensive index.

27-85. **Dictionary of Metal Finishing Chemicals.** Nathaniel Hall and G. B. Hogaboom, Jr. 129 p., Metal Industry Publishing Co., 11 West 42nd St., New York 18, N. Y. $3.00.

A dictionary of chemical terminology used in metal finishing and electroplating in particular. Data included pertinent to identification and determination of reactions. Density tables included giving degrees Baume and specific gravity of solutions of common salts.

27-86. **Quin's Metal Handbook and Statistics, 1945.** 367 p., Metal Information Bureau, Ltd., Princes House, 39 Jermyn St., London, S.W.1, England. 10 s.

Statistics and tables covering world consumption and

production, exports and imports by country, prices, properties and uses, weights and other pertinent data for all the metals. Highest and lowest prices since 1800 are listed and tables of measures, weights and physical constants are included.

27-87. **Dr. W. C. Röntgen.** Otto Glasser. 169 p., illus., Charles C. Thomas, Bannerstone House, 301-307 E. Lawrence Ave., Springfield, Ill. $4.50.

Biography of the discoverer of the X-ray. An appendix lists his scientific papers, chronology of his life, and bibliography of other sources of information.

27-88. **Metallography and Heat Treatment of Steel.** N. F. Bolhovitinov. Novoe Shoss 33, Moscow 8, U.S.S.R. 319 p. (In Russian.)

Elementary principles; properties and uses of cast iron, carbon and alloy steels, and the main nonferrous alloys. Examples of metal selection and heat treatment for characteristic machine parts. Metallography and the addition of modifiers and intensifiers to steel. Hardenability and isothermal transformation diagrams.

27-89. **Theory and Methods of Research on Metallic Corrosion.** G. W. Akimow. 414 p., Academy of Science of U.S.S.R., Moscow, U.S.S.R (In Russian.)

Classification of corrosion; chemical corrosion and protective films; theory of electrochemical corrosion; electrode potentials; processes of electrochemical corrosion; factors of corrosion; rate and distribution of corrosion; classification of testing methods; laboratory methods; electrochemical methods; field tests and full-size tests.

27-90. **A Study of the Accelerated Speed of Scientific Invention.** International Economic Research Bureau, 76 William St., New York 5, N. Y. $5.00.

A business survey compiling the results of hundreds of interviews with key executives intended to foretell how coming changes in technology will affect business and investments.

27-91. **The Aluminum Industry.** Stanley V. Malcuit. 36 p., Bellman Publishing Co., Inc., 83 Newbury St., Boston 16, Mass. $1.00.

A vocational and professional monograph giving specialized information about jobs in the aluminum industry. Analytical index of occupations; personal qualifications required; scholastic training needed; employment opportunities; remunerations received; chances for advancement; advantages and disadvantages; possibilities for both men and women.

27-92. **Scientific Instruments.** Herbert J. Cooper. 304 p., illus., Chemical Publishing Co., Inc., 26 Court St., Dept. Y, Brooklyn 2, N. Y. $6.00.

In five sections: optical instruments; measuring instruments; navigational and surveying instruments; liquid testing; miscellaneous. Description of various instruments; principles on which they are based; methods of measurement.

27-93. **X-Rays in Practice.** Wayne T. Sproull. 615 p., illus., McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 18, N. Y. $6.00.

Nature of X-rays; how they are applied; the equipment used; numerous applications such as industrial radiography, medical, for studying molecular structure. Covers electron diffraction, fluoroscopy, automatic inspection, and microradiography.

27-94. **Manual of Design for Arc Welded Steel Structures.** LaMotte Grover. 300 p., Air Reduction Sales Co., Dept. MD, 60 East 42nd St., New York 17, N. Y. $2.00.

Fundamentals of design, materials, inspection, estimating and engineering control of welding and related operations. Chapters cover electrode requirements, specifications for welded connections for all sizes of rolled beams, and a series of diagrams for the rapid design of welded connections.

27-95. **Statistical Yearbook of the League of Nations, 1942-44.** 315 p., Columbia University Press, New York, $3.50 cloth bound; $2.50 paper bound.

This standard reference book includes production figures for metals and ores, petroleum products, coal, lignite, wood pulp, livestock, fisheries, and products of agricultural origin. In most cases, annual figures are given from 1934 through 1943, and sometimes for earlier years. The statistics are also tabulated by continents and by countries.

27-96. **Collected Abstracts Published During 1945 on Spectrochemical Analysis.** Edwin S. Hodge. 64 p., Ohio Valley Spectrographic Society, Engineers Club Bldg., Dayton, Ohio. $1.00, cash with order; $1.25 when billing is required.

Verbatim copy of all the abstracts published during 1945 by *Chemical Abstracts* on articles dealing with spectrochemical analysis. Over 80 references, arranged according to topics, well indexed.

27-97. **Industrial Electric Heating and Electrical Furnaces.** Edwin Stoddard Lincoln. 201 p., Duell, Sloan & Pearce, New York, N. Y. $3.00.

Explanations of industrial electric heating installations and the various kinds of electric furnaces.

27-98. **Workshop Technology.** William Arthur James Chapman. Part 1—311 p.; Part 2—336 p. Longmans, Green & Co., 55 Fifth Ave., New York 3, N. Y. Part 1—$1.50; Part 2—$2.50.

A comprehensive textbook of English machine shop practices. Part 1 is "An Introductory Course".

27-99. **Directory of Steel Foundries in the United States and Canada, 1946.** Steel Founders' Society of America, 920 Midland Bldg., Cleveland 15, Ohio. $10.00.

Names and addresses of all known steel foundries in the two countries, together with executive personnel and data on production facilities, size and type of castings produced, number of employees and similar information.

27-100. **Heat Treatment of Carbon Steels.** F. Johnson. 204 p., illus., Chemical Publishing Co., Inc., 26 Court St., Brooklyn 2, N. Y. $4.00.

Various methods and apparatus used in the heat treatment of carbon steels, the effect of composition and heat treatment on the physical properties of the finished product, and the tests used for determining the physical constants and mechanical properties of steel.

27-101. **Industrial Carbon—Its Elemental, Adsorptive, and Manufactured Forms. Second Edition.** C. L. Mantell. 472 p., illus., D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N. Y. $7.50.

Technologic applications of elemental carbon, aside from its use as a fuel. Diamonds and graphites, carbon pigments and fillers, adsorbent carbons, manufactured carbon products such as electrodes and brushes.

27-102. **English-French and French-English Technical Dictionary.** Francis Cusset. 590 p., Chemical Publishing Co., Inc., 26 Court St., Brooklyn 2, N. Y. $5.00.

Covers the fields of metallurgy, mining, electricity, chemistry, mechanics, and sciences. Includes a section on the conversion of French metrical system of measurement to the English system.

27-103. **Standard Metal Directory. 1946 Edition.** 842 p., Atlas Publishing Co., 425 W. 25th St., New York 1, N. Y. $10.00.

Directory is in four sections: iron and steel plants; ferrous and nonferrous metal foundries; metal rolling mills; smelters and refiners of nonferrous metals. Plants are listed geographically and alphabetically. Reports give name of the company, its capitalization, when organized, location of the plants, location of main office, names of company's officers, plant equipment, products manufactured and types of primary and secondary raw materials consumed.

27-104. **Government Statistics for Business Use.** 432 p., John Wiley & Sons, New York. $4.07.

Prepared by 20 experts in the various fields of government statistics. The major sources of statistical information are briefly described, and application to business and economic problems is discussed. Among the fields covered are manufacturing, mineral statistics, international trade, prices and labor. Indexed.

27-105. **Welding Aluminum.** 88 p., Reynolds Metals Co., 2500 South Third St., Louisville 1, Ky. $1.00.

Comprehensive review of the latest practices and recommendations for joining aluminum and its alloys by gas, arc, and resistance welding. Chapters on brazing and soldering are included, as well as general information as to the weldability of the more widely used alloys.

27-106. **Aluminum Alloy Selector.** Reynolds Metals Co., Dept. 47, 2500 South Third St., Louisville 1, Ky. $1.00.

Slide-rule type of chart, 8½ x 11 in. in size, from which it is possible to obtain a mass of technical information concerning 18 of the most widely used aluminum alloys. Alloys covered include, 2S, 3S, 14S, 17S, 18S, 24S, Pureclad 24S, 25S, 32S, A51S, 52S, R353, 56S, R361, R301, R303, Clad R303, R317. By setting one slide for the alloy

and the other slide for the product, the user has available in handy form data on mechanical properties, chemical composition, physical constants, thermal treatments and specifications.

27-107. **Oxy-Acetylene Welding Repair Manual. 6th Edition.** C. G. Bainbridge and F. Clark. 212 p., Porteous, Ltd., England. 6s. 6d.

Work is designed specially for garage and general repair shop welders, blacksmiths, agricultural engineers, automobile, and sheet metal workers.

27-108. **Stabilization of 18% Cr, 8% Ni Corrosion Resisting Steel.** Samuel J. Rosenberg. *National Bureau of Standards Report,* no. 7, Aug. 23, '46, 6 p., 45 tables.

Results of the sixth, seventh, and eighth phases of test program involving study of susceptibility to intergranular attack of test steels as initially cold rolled (37½% cold reduction), followed by different preliminary treatments.

27-109. **Increasing the Compressive Strength of 24S-T Aluminum-Alloy Sheet by Flexure Rolling.** George J. Heimerl and Walter Woods. *National Advisory Committee for Aeronautics,* Technical Note no. 1119, Aug. '46, 5 p.

In method described sheet was alternately bent and then straightened by rolling in a four-step procedure. Includes method of testing, results, discussion, and conclusion.

27-110. **An Electron-Microscope Study of Used Nitrided Steel Piston Rings.** Thomas P. Clark and Walter A. Vierthaler. National Advisory Committee for Aeronautics, Technical Note no. 1132, Sept. '46, 22 p.

Critical study of altered surface layers found on nitrided steel piston rings run in nitrided steel cylinder barrels was conducted to determine the physical and chemical characteristics of the altered layers and the mechanism by which these coating layers were formed. Electron microscope was used for examination of areas that heretofore could be studied only by electron and X-ray diffraction. Light microscope was used to study gross microstructures and oxidation color patterns.

27-111. **Use of Tools; Phototold in Four Hundred and Twenty Pictures.** 238 p., illus., diagrs. Infantry Journal, Washington, D. C. $3.50.

Handy information on the use and care of general tools.

27-112. **Radiographic Inspection of Metals.** Otto Zmeskal. 150 p., Harper & Brothers, New York. $2.75.

An introductory textbook presenting the principles and practice of radiography. No attempt is made to discuss physical theory or X-ray apparatus.

27-113. **Industrial Research and Development in the United Kingdom.** H. Frank Heath and A. L. Hetherington. 375 p., Faber and Faber, Ltd., 24 Russell Square, London, W.C.1, England. 25s.

Survey of industrial research and development in the United Kingdom up to the end of 1944, written for laymen. Includes chapters on chemical industries, coal, gas, glass, oil, paint, photography, plastics, pottery, printing, refrac-

tories, rubber, scientific instruments, textiles, metals, the food industries, and production engineering. Sections on governmental and institutional research and general factors affecting industrial progress.

27-114. **Applied Elasticity.** John Prescott. 666 p., Dover Publications, New York. $3.95.

Subject matter is presented from the viewpoint of the engineer rather than from that of the mathematician. Solution of practical problems emphasized.

27-115. **Crushing Strength of Thin Steel Webs.** George Winter and R. H. J. Pian. 24 p., Cornell University, Ithaca, New York. (Engineering Experiment Station Bulletin no. 35, part I.)

Results of 136 tests carried out to determine the crushing strength of webs under various conditions of loading. Empirical formulas are deduced from these tests which alloy determination of the crushing strength with a reasonable degree of accuracy. Recommendations are made as to the factor of safety to be applied for the use of these formulas in practical design.

27-116. **Investigation Into the Behavior of Welded Rigid Frame Structures. Fourth Interim Report.** J. F. Baker. *British Welding Research Association,* Ref. FEI.-5/24, Dec. '45, 16 p.

Gives approximate methods of calculating the collapse loads in stanchions bent in single curvature.

27-117. **Metal Statistics Year Book. 1945.** American Bureau of Metal Statistics, 33 Rector St., New York 6, N. Y. $3.00.

Twenty-fifth year book summarizing metal statistics through 1945.

27-118. **The Machining of Steel.** F. C. Lea and Eric N. Simons. 214 p., Blackie & Son, Ltd., London. 8s. 6d.

Explains fundamental principles of workshop machines and tools. Lathe, planer, shaper, miller, driller, breacher and sawing machine are all dealt with; descriptions of the machines, speeds and feeds, jigs, gages, coolants and tools.

27-119. **1946 Book of A.S.T.M. Methods of Chemical Analysis of Metals.** 402 p., American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $3.00.

Contains all current A.S.T.M. methods for chemical analysis of ferrous and nonferrous metals and their alloys. Included are photometric, polarographic and spectrographic methods.

27-120. **S.A.E. Handbook. 1946 Edition.** 842 p., Society of Automotive Engineers, 29 W. 39th St., New York 18, N. Y. $5.00.

S.A.E. standards and recommended practices for aeronautical parts and materials; units, parts and fittings; processed materials; fabricated materials; screws, bolts and washers. Also contains sections on tests, ratings and codes, transportation and maintenance; tools and production equipment; nomenclature, tolerances and conversions.

27-121. **Transactions of the American Institute of Mining and Metallurgical Engineers, Volume 163, 1945.** 635 p.,

American Institute of Mining and Metallurgical Engineers, 29 W. 39th St., New York 18, N. Y. $5.00.

Papers and discussions on mining practice presented at meetings held at New York, Feb. 17-20, 1941; Feb. 15-18, 1943; Feb. 20-24, 1944; at Los Angeles, Oct. 19-20, 1944; Chicago, Feb. 25-28, 1946; and other contributions.

27-122. **Electric Furnace Steel Proceedings A.I.M.E., 1945, Volume 3.** 289 p., American Institute of Mining and Metallurgical Engineers, 29 W. 39th St., New York 18, N. Y. $5.00.

Papers and accompanying discussion include several on each of the following: ideal conditions for fast melting; new methods for temperature measurement; furnace and ladle refractories; pouring practice; stainless steel melting practice; graphitization; production of alloy steels.

27-123. **Atomic Theory for Students of Metallurgy.** William Hume-Rothery. 286 p., 124 illus., Institute of Metals, 4 Grosvenor Gardens, London, S.W. 1, England. 7s., 6d.

An expansion to double size of the same author's "Structure of Metals and Alloys" (1936) presenting fuller explanation of the present views of atomic structure and interatomic forces, the whole matter simplified as much as an essentially mathematical subject can be. Newcomers to modern physical thought would do well to start with Hume-Rothery's current series of articles in *Metal Industry* (London) entitled "Electrons and Metals", which are supposed "conversations between an older metallurgist and a young scientist". Next the ambitious student could take up the 1936 book, and finally graduate into this present excellent work. The latter would read well after browsing around in some of Sir James Jeans's books on philosophy, physics and astronomy. Some glimmerings of these subjects are part of the essential mental equipment of the sentient citizen of the post-Hiroshima era. (E. E. T.)

27-124. **Die Casting and Permanent Mold Casting.** Alfred Sugar. 48 p., American Metal Co., Limited, New York.

Series of lectures covers history, description of equipment, alloys for die casting, cores, mold and die design and construction, mold preparation, temperature control.

27-125. **Oxygen-Free High Conductivity Copper.** 50 p., American Metal Co., Limited, New York.

A compilation of information on properties and applications, with indexed bibliography of 81 references.

27-126. **Metal Cutting Data Sheets.** American Society of Mechanical Engineers, Publication Sales Department, 29 W. 39th St., New York. $15.00 for 12 issues.

A new publication beginning with July 1946 issue, in form of 8½ by 11-in. punched, loose-leaf sheets. Subject matter is presented under ten divisions of the metal-cutting industry. Each subscriber is provided with a set of index cards to facilitate filing.

27-127. **Gear Design Simplified.** The Industrial Press, 148 Lafayette St., New York 13, N. Y. $3.00.

Book of working rules and formulas for designer and shop man; deals with spur gears, internal gears, straight-

tooth and spiral-bevel gears, single and double-helical gears, worm gears, gear ratios (including transmissions of the planetary type), and the power-transmitting capacity of gears. All gear problems are presented in simple chart form.

27-128. **Ingenious Mechanisms for Designers and Investors.** 2 volumes, v. 1, 536 p.; v. 2, 538 p., The Industrial Press, 148 Lafayette St., New York 13, N. Y. $8.00 set or $5.00 for each book separately.

Comprehensive encyclopedia of mechanical movements.

27-129. **Wood Patternmaking.** Herbert J. McCaslin. 366 p., McGraw-Hill Book Co., Inc., New York; available through Penton Publishing Co., Cleveland, Ohio. $2.60.

Text includes examples of match and followboard work, application of cap core, skeleton pattern construction, core frame setups for molds to be assembled from dry sand bodies, core-box and mold arrangement for the casting of interlocking members, efficient use of machine tools, inspection checking and recording of patterns, and expanded glossary of patternmaking and molding terms.

27-130. **Potential Hazards in Molten Salt Baths for Heat Treatment of Metals.** 40 p., National Board of Fire Underwriters, New York. (N.B.F.U. Research Report No. 2.)

Fire and explosion hazards likely to be encountered through the use of molten salts as heating mediums in the heat treatment of various metals and alloys. A number of typical salt bath incidents involving fires and explosions are summarized. This is followed by a detailed discussion of the hazards of the process and the causes of the incidents. Final chapter recommends a series of precautionary measures and safeguards which will facilitate the safe operation of the process. Proper fire fighting instructions are included. 21 ref.

27-131. **Underground Corrosion.** Kirk H. Logan. 312 p., National Bureau of Standards, Washington, D. C. $1.25.

An assembly of the results of the National Bureau of Standards investigations of underground corrosion which began in 1922. Fundamental causes and processes; results for different metals and alloys; various coatings for corrosion protection. Describes several methods for testing soils and coatings and discusses their usefulness.

27-132. **The Electron Microscope.** E. F. Burton and W. H. Kohl. Second Edition. 325 p., Reinhold Publishing Co., 330 W. 42nd St., New York, N. Y. $3.41.

Presents the physical principles upon which the electron microscope is based, without any assumptions in regard to the technical knowledge of the reader. Contains many pictures and simple diagrams and an extensive bibliography.

27-133. **Le Zinc et Ses Alliages.** R. Grunberg, M. Marechal, H. Patin, and E. Wagner. Preface by A. Portevin. 233 p., Dunod, Paris.

Methods of extraction of zinc and its characteristics and uses; mechanical properties of rolled zinc; zinc alloys, including casting methods. Welding and brazing, corrosion characteristics, and methods of analysis.

27-134. **Fifty-Second Annual Report of the Ontario Department of Mines. 1946.** 277 p., Ontario Department of Mines, Toronto.

Statistical review of mineral industry for 1942; list of mines, quarries, and works, brief descriptions of each mine, and accident statistics.

27-135. **Proceedings of the Institute of British Foundrymen.** Edited by John Bolton. v. 38, The Institute, St. John Street Chambers, Deansgate, Manchester, 3.

Ten papers which are predominantly nonferrous in character; five of general interest (sands and the like); four cover gray iron; and three each for malleable and steel.

27-136. **Biennial Report 1943-1945.** 111 p., Office of the Commissioner of the Iron Range Resources and Rehabilitation, St. Paul, Minn.

Surveys resources and possibilities for future development in the "cut-over" area in which the iron range is located. The three sections treat of agriculture, mining, and forestry, respectively. Mining section includes discussion and statistics on analysis; production from open-pit and underground mines from the three ranges; labor costs; tax distribution and methods; employment opportunities; and research in concentration of taconite, on production of iron powder from "carbonate slate", and on use of hydrogen for reduction of iron ores.

27-137. **Modern Furnace Technology.** H. Etherington. Second edition, revised. 522 p., Charles Griffin and Co., Ltd., London.

Explains scientific principles underlying the various phases of modern furnace design and operation, and shows how these principles may be applied to achieve operating improvement. Special effort has been made to present the more complex aspects of the subject in the simplest possible manner, and to provide simplified yet accurate methods of calculation.

27-138. **Steel Castings.** Eric N. Simons. 208 p., Paul Elek, Ltd., Diamond House, 36-38 Hatton Garden, London, E.C.1., England. 13s.

Production of steel castings; buying of castings; descriptions of various types of steel castings. Manufacturing process is dealt with step by step from the raw materials. Among the processes treated are centrifugal casting and the pot-casting method. Chapter on molding sands gives certain standard methods of testing.

27-139. **Proceedings of the Mining and Metallurgical Society of America. Volumes 37 and 38. 1944-1945.** 91 p., School of Mines, Columbia University, New York, N. Y.

Includes routine business of the Society and discussions of mineral controls and mine tax policy.

27-140. **A.S.T.M. Standards on Electrical Heating and Resistance Alloys (With Related Information).** 173 p., American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $2.00

Specifications and methods of testing that have been issued by the American Society for Testing Materials for

the following classes of products: electrical heating materials; electrical resistance materials; structural and electrical resistor materials for furnaces; thermostat metals; materials for incandescent lamps and radio tubes; and electrical contact materials.

27-141. **A.S.T.M. Standards on Copper and Copper Alloys.** 465 p., American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $3.75.

Standard and tentative methods of test, and specifications pertaining to copper and copper alloys, cast and wrought copper and copper alloys for electrical conductors, nonferrous metals used in copper alloys.

27-142. **Selected A.S.T.M. Standards for Students in Engineering.** 255 p., American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Compilation is designed primarily to illustrate different representative types of specifications for the engineering student, and especially to include a few of the standards that can be linked closely to parts of the work in materials testing as commonly taught. Includes selected test methods for metallic and nonmetallic materials and selected specifications for ferrous and nonferrous metals and nonmetallic materials.

27-143. **Proceedings of the Society for Experimental Stress Analysis, v. 3, part 2, 1946.** 166 p., Addison-Wesley Press, Inc., Cambridge 42, Mass. $5.00.

The sixth of a series of compilations of stress analysis papers. Sections concern: stress in spur gear teeth, mechanical failures of steel plant equipment, allowable working stresses as determined by physical properties, and fatigue failure of manufactured parts. The paper discussing allowable working stresses offers data of unique value in the form of 28 tables and curves. Given are tensile-hardness relationships, maximum mean working stress curves for materials of various hardnesses, and other charts of equal value.

27-144. **Deformation and Fracture of Metals Under Static Dynamic Loadings.** Ya. B. Fridman. 228 p., All-Union Institute of Aviation Materials; Moscow. 20 rubles.

Presents the author's views gained during several years' experience and research on various aspects of the mechanical testing of metals at the Aviation Materials' Institute, Moscow. Relation to previous work is discussed in detail, and valuable summaries of results, particularly of Russian and American investigators, are given. There are 229 references covering the period up to 1944 and part of 1945. Does not touch upon wear, fatigue, creep, and other complex forms of deformation and fracture. (From lengthy review in *Metallurgia,* v. 34, Sept. '46, p. 248-249.)

27-145. **Handbook of Cupola Operation.** 470 p., American Foundrymen's Association, 222 W. Adams St., Chicago 6, Ill. $4.50 to A.F.A. members, $5.50 to nonmembers.

Cupola construction, successful operation, charges, blowers, etc. Devoted to methods, materials, and results as reported by practicing foundrymen.

27-146. **Symposium of Papers on Statistical Quality Control.** 76 p., Quality Control Panel, Birmingham District Production Committee, Ministry of Production, Birmingham 3, England.

A collection of papers discussing the application of statistical methods of quality control to industrial problems. Opening paper is a general introduction to the problem of where and how to use the methods in a plant. Three application papers present the kinds of problems which are met in practice, their solution, and the general economic value of control chart methods. They include two on application to press shop operations. Four other papers discuss various statistical techniques. (From review in *Journal of the American Statistical Association,* v. 41, March '46, p. 121-122.)

27-147. **Chambers's Mineralogical Dictionary.** 82 p., W. & R. Chambers, Ltd., Edinburgh, London.

Compendium of mineralogical terms includes some 40 color plates, each containing reproductions of several minerals. Text consists of some 1400 short definitions.

27-148. **Workshop Technology. Part 2.** William A. Chapman. 328 p., Edward Arnold, London, England.

Machine tools in general, and the operations of turning, shaping, planing, slotting, milling, drilling and boring, and grinding. Chapters on accuracy, interchangeability and gaging, and on measurement and precision work; appendices dealing with various standards and specifications.

27-149. **Rarer Metals.** Jack De Ment and H. C. Dake. 392 p., Chemical Publishing Co., 26 Court St., Brooklyn 2, N. Y. $7.50.

Mineralogy, chemistry, physics, and technology of the following metals: beryllium; gallium; indium; thallium; germanium; titanium; zirconium; hafnium; thorium; vanadium; columbium; tantalum; molybdenum; tungsten; uranium; selenium; tellurium; platinum; palladium; rhodium; iridium; osmium; ruthenium. Each is considered in turn, according to the following arrangement: history, mineralogy, physical and chemical properties, compounds, extraction, technology, and analysis. Major emphasis is on metallurgical and ceramic applications, with only brief reference to chemistry. Each chapter is followed by numerous references, and there is an abridged bibliography at the end of the book.

27-150. **Treatise on Milling and Milling Machines.** Edition 3. Section 1. 182 p., Cincinnati Milling Machine Co., Dept. MWE, Marburg & Klein St., Cincinnati, Ohio. $1.00.

Functions and operations of milling machines as well as the cutting tools used for milling operations. Typical examples of milling, illustrating actual equipment installed in manufacturing plants, suggest the right kind of fixtures and work chucking devices, as well as the most economical cycle of operations.

27-151. **Contour Sawing.** V. 1, 263 p., The DoAll Co., 1301 Washington Ave., South, Minneapolis 4, Minn.

Book is divided into two sections—one covering conventional, the other high-speed sawing procedures, including work projects and tests to be given trainees as well as

grading data. Step-by-step procedures, description of parts to be used, as well as photographs, charts, and recommendations are included.

27-152. **Thin Films and Surfaces.** W. Lewis. 70 p., English Universities Press, Ltd., Little Paul's House, London, E.C. 4, England. 15s.

Structure of metal surfaces and of surface films (of oxide, etc.) is first considered with special reference to the structure of thin films. Production of thin metallic films is next dealt with, followed by a section discussing the mechanical, optical, magnetic, and electrical properties of metallic films and surfaces.

27-153. **Statistical Methods in Quality Control. Engineering Data Book Section 29.** P. C. Clark and G. R. Armstrong. 100 p., Hunter Pressed Steel Co., Lansdale, Pa.

Presents in looseleaf style a description of the quality control methods which have been found useful by the Hunter Pressed Steel Co. Pages are exact reproductions of data sheets which were prepared by the company for their inspectors and inspector trainees, being in large part specific operational procedures to be followed by the inspection personnel. First part deals with frequency distribution; second with correlation between two quality characteristics; and last with control charts. (From review in *Journal of the American Statistical Association,* v. 41, March '46, p. 130-131.)

27-154. **Machine Shop Estimating.** W. A. Nordhoff. 400 p., McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. $5.00.

Machine shop reference book deals with the time required by normal machine operators to perform various machining operations. Lists all the elements of operations performed in an average machine shop and establishes reasonable time values for their execution by the average operator. Machining elements which are generally variable are given in tables. Normal shop practice of feeds, speeds and cutting tool quality is indicated. Sample estimates are shown for all machine operations.

27-155. **Advanced Mechanics of Materials.** Glenn Murphy. 350 p., McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. $4.00.

Topics covered include the relationships among stresses and strains at a point; thick-walled cylinders; theories of failure; axial loading; stress concentrations; torsion of noncircular members; unsymmetrical bending; curved beams; shear center; stresses near concentrated loads; and buckling of panels, sheets and thin-walled members. Emphasis is placed upon the tools available for investigating new problems and upon the way those tools are applied. Latest developments are included, as well as many references to recent articles.

27-156. **Principles of Tool Engineering.** Raymond R. Bloom. 234 p., McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, 18, N. Y. $2.40.

Important principles of the subject. Twenty practical problems follow the instructional material. Includes a correlated list of visual aids.

27-157. **Structural Metal Painting Literature Review.** 54 p., National Lead Co. Research Laboratories, Brooklyn, N. Y.

A series of 11 articles, considered to be from unbiased sources, has been condensed and is presented in this review. Articles reported were selected after a careful search of available literature from all material pertinent to the subject published within the period of 1936-1945.

27-158. **Corrosion and Preservation of Iron and Steel.** A Bibliography 1936-1945. 135 p., National Lead Co. Research Laboratories, Brooklyn, N. Y.

Abstracts on the subject which appeared in *Chemical Abstracts* from 1936 to 1945 have been arranged in accordance with a classification scheme, which is shown in the table of contents. First large section covers corrosion theory and causes, while the second section covers corrosion prevention and testing. Includes pickling and surface coating methods, but not anodic methods. Contains 923 items.

27-159. **The Mineralogy and Geology of the Taconites and Iron Ores of the Mesabi Range, Minnesota.** John W. Gruner. 127 p., Office of the Commissioner of the Iron Range Resources and Rehabilitation, St. Paul, Minn.

Omits geology of the formations older and younger than the iron-bearing formation and any discussion as to the origin of the formation and of the ores. Includes the silicates, the taconites, the magnetites, the hematite-limonite deposits, and the oxidized low grade ores. Discusses the possible use of iron carbonate taconite of the Lower Slaty division as a source of iron powder.

27-160. **Microcalorimetry.** W. Swietoslawski. 199 p., Reinhold Publishing Corp., 330 W. 42nd St., New York 18, N. Y.

Gives a comprehensive description of the methods used in measuring small amounts of heat developed by different objects. It covers methods of comparative measurements; calorimeter and temperature measuring instruments; static and kinetic methods; measurements of heat developed in processes of long and short duration; the ice calorimeter; the adiabatic microcalorimeter; the labyrinth flow calorimeter; twin microcalorimeters; and choice of a method to be used for a specific problem. Applications are found scattered throughout the book. 130 ref.

27-161. **Reagent Chemicals and Standards.** Joseph Rosin. Second Edition. 542 p., D. Van Nostrand Company, Inc., 250 Fourth Ave., New York, N. Y.

A compilation of methods of assaying and testing chemicals; also the preparation and standardization of volumetric solutions and extensive tables of equivalents. This second edition contains 52 additional reagents. Methods of testing for impurities, as well as their quantitative determination, have been revised in accordance with more recent procedures.

27-162. **Specification for the Design of Light-Gage Steel Structural Members.** 39 p., American Iron and Steel Institute, 350 Fifth Ave., New York 1, N. Y.

Design provisions governing shapes made up of flat or straight elements such as most commonly encountered in the design of structural members formed of light-gage

steel. Endeavor has been made to simplify design procedure by including design tables, curves and charts, and illustrative examples. The specification has four appendices which deal with problems of application of the specification.

27-163. **Statistical Quality Control.** Eugene L. Grant. 263 p., McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 18, N. Y. $5.00.

Deals with laws of probability that may be used to improve acceptance procedures and thus secure the best possible quality assurance from a given inspection cost. Explains the Shewhart control chart, its use in manufacturing to reduce costs of spoilage and rework, and to obtain a better coordination between design, production and inspection. Careful explanation of basic principles is accompanied by many practical examples demonstrating the broad usefulness of quality control techniques in dealing with quality problems in mass production.

27-164. **Metal Industry Handbook and Directory.** 1946 Edition. 484 p., The Louis Cassier Co., Ltd., Dorset House, Stamford St., London, S.E. 1, England.

In four sections: general properties; general data and tables; electroplating, finishing, galvanizing, anodizing; and directory. The sections on "Properties of the Principal Metals" and "Properties of Some of the Rarer Metals" have been extensively revised; this applies particularly to uranium. Revision has been made in the sections covering all the official British specifications for nonferrous alloys, to bring these up to date.

27-165. **Heat Treating Aluminum Alloys.** 144 p., Reynolds Metals Co., Department 47, 2500 South Third St., Louisville 1, Ky. $1.00.

First section presents easily understandable concepts which the nontechnical reader can follow. Section 2 presents in brief tabular form the recommended thermal treatments for the various aluminum alloys. Section 3 is for the metallurgist and operating personnel, and gives a more technical discussion of the various thermal treatments, as well as information on possible difficulties and suggestions for their cure.

27-166. **Machining Aluminum Alloys.** 124 p., Reynolds Metals Co., Department 47, 2500 South Third St., Louisville 1, Ky. $1.00.

General discussion of machining characteristics of the various aluminum alloys; machining conditions; tool materials and designs; cuts, speeds and feeds, lubricants, coolants and cutting compounds. Individual discussions of the different machining operations. Eight charts or tables make available in compact form specific and easily usable recommendations for eight of the most important machining operations.

27-167. **Galvanizing Handbook.** John R. Daesen. 166 p., illus., Reinhold Publishing Corp., 330 West 42nd St., New York 18, N. Y. $5.25.

Presents graphically the basic principles involved and demonstrates with photographic examples the nature and

cause of many defects encountered in a consulting practice in a varied field. Many of the examples chosen were articles deliberately spoiled to indicate in an extreme manner conditions which are difficult to illustrate in the degree usually encountered in practice.

27-168. **Identification and Qualitative Chemical Analysis of Minerals.** Orsino C. Smith. 386 p., D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N. Y. $6.50.

Both wet methods and blowpipe tests for analysis of more than 2000 minerals. Actual appearance shown by many natural color plates. Minerals are classified by specific gravity and hardness in tables that also give other properties useful in identification.

27-169. **A Bibliography of Statistical Quality Control.** Grant I. Butterbaugh. 114 p., paper bound, University of Washington Press, Seattle, Wash. $1.50.

An annotated bibliography of books and articles limited to *statistical* quality control. Approximately 340 authors are represented in the 712 articles, manuals, and books listed.

27-170. **Minerals Yearbook, 1944.** 1636 p., Bureau of Mines, Washington, D. C. (Also Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.) $3.00.

Volume departs from 1943 edition in but one main respect—the chapter on International Aspects of War Mineral Procurement has been greatly expanded so as to include a section on Foreign Minerals Review, with particular emphasis on Latin-American countries. (Review from *Materials & Methods,* v. 24, Nov. '46.)

27-171. **Fuels, Combustion and Furnaces.** John Griswald. 494 p., McGraw-Hill Book Co., 330 West 42nd St., New York, N. Y. $5.50.

Text suitable for the fourth year of a chemical engineering curriculum. Covers fundamental background and more essential specific details of the technology, combustion properties, and utilization of fuels, as well as the apparatus and equipment involved. Includes a large number of tables, diagrams and pictures, problems and references following each chapter, and an extensive appendix of tables.

27-172. **The Influence of Port Design on Openhearth Furnace Flames.** J. H. Chesters and M. W. Thring. Special Report No. 37, Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W. 1, England. Free to members; 16s. to nonmembers.

Experiments made to determine the influence of various design factors on combusion, heat transfer, and gas flow. External factors, such as the gas and air flow, gas quality, preheat temperatures, gas pressures, CO_2 in waste gases, and metallurgical load were carefully measured and various instruments were used to study internal radiation. Flame location, velocity and stability, together with the rate of mixing of the gases, were studied by means of slow-motion films, and by a multiple sampling probe inserted through the roof.

27-173. **Spectrographic Analysis of Metallurgical Products.** 92 p., Centre de Documentation Siderurique, 12 Rue de Madrid, Paris 8, France.

Proceedings of fifth congress of French society for the improvement of methods of spectrographic analysis of metallurgical products. Includes Le Dosage Spectrographique des Faibles Teneurs en Aluminium dans les Aciers Ordinaires et Speciaus, by R. Castro; Causerie sur les Spectrographes, by H. Tardy; Luminosité Comparée du Spectrographe Ziess Qu 24 et du Spectrographe Zelande de Jobin et Yvon, by E. Loeuille; and Le Dosage des Traces d'Impurétés dans les Alliages de Zinc au Moyen de l'Etincelle Condensee, by P. Croissant.

27-174. **Outline of the History of the Academy of Sciences of U.S.S.R.** I. P. Bardine, editor. 68 p., Academy of Sciences of U.S.S.R., Moscow. (In Russian.)

Reviews research work at the Academy from its foundation to the present in applied science, namely: power engineering, fuels, mining, metallurgy, mechanics, mechanical engineering, automatic control engineering, electric welding, radio, transportation, and problems of water utilization. Also covers scientific nomenclature and the history of technology.

27-175. **Proceedings of the Seventh Annual Forum Porcelain Enamel Institute, 1945.** 141 p., Porcelain Enamel Institute, Chicago, Ill. $2.00.

Papers include: "Preparation of Sheet Metal for Porcelain Enameling" by B. T. Sweely; "Nickel Dipping" by G. H. McIntyre; "Milling and Mill Additions" by G. H. Spencer-Strong; "Reclaiming Enamels" by Herman L. Cook and William D. Caldwell; "Dipping and Spraying" by J. E. Hansen; "Drying and Firing" by A. I. Andrews; "The Application of Electrostatic Spraying to Porcelain Enamel" by L. G. Goldberg; "Color Standardization and Problems Involved in Matching Paints and Porcelain Enamels" by Norman F. Barnes; and "Spraying Vs. Dipping Ground Coat Enamels" by Paul E. Gerdes.

27-176. **Le Cobalt.** Robert Perrault. 151 p., Dunod, Paris. 390 francs.

A brief history of cobalt is followed by a description of the various minerals in which it is found. Several methods of extracting the metal are given and flow diagrams illustrate these processes. Other chapters cover properties and applications with emphasis on cobalt's employment as an alloying constituent in steels and other alloys. A final chapter on economic considerations and a bibliography complete the volume.

27-177. **Metallizing Handbook.** 86 p., Metallizing Engineering Co., Inc., Long Island, N. Y. $2.00.

Data on preparation of surfaces, metallizing technique and finishing procedure, corrosion resistance, specific gravity, hardness, bond strength, tensile strength and relative shrink.

27-178. **Machine Operation Times for Estimators.** Joseph C. Derse. 156 p., Ronald Press Co., 15 East 26th St., New York, N. Y., $6.00.

Directly usable presentation of procedures for determination of machine and operation times for a wide range of work. Methods for applying the standard elemental times in making detailed estimates. Case examples for numerous typical jobs are worked out in full detail, with drawings of parts, diagrams of tool setups and detail estimate sheets filled with selected data. (From review in *Steel,* v. 119, Dec. 9, '46.)

27-179. **Report on Ferrous and Nonferrous Data.** Compiled by A. E. White and C. A. Siebert. 591 p., Office of Technical Sciences, Department of Commerce, Washington. $40.00 for photostat edition and $6.00 for microfilm edition.

Based on information available as of September 1941. Report consists of seven volumes of data, classified in two main sections, nonferrous metals and alloys, and ferrous alloys. Each group subdivided according to alloy types; composition, heat treatment, tensile test data and impact properties are given. (From review in *Steel,* v. 119, Dec. 9, '46.)

27-180. **Mechanical World Year Book 1946.** 360 p., Emmott & Co., Ltd., 21, Bedford St., Strand, London W.C.2, England. 2s, 6d.

Pocket-size manual of information on machine-shop practices, light alloys, plastics, bearings, steam boilers, turbines, internal-combustion engines, welding, and other topics of interest to manufacturers and mechanical engineers.

27-181. **Mechanical Measurements by Electrical Methods.** Howard C. Roberts. 357 p., illus., Instruments Publishing Co., Inc., Pittsburgh, Pa. $3.00.

Lists and describes the basic principles of circuits and systems and discusses their applications. The 330 bibliographical references cover the most useful published material. Methods described are most useful to the civil or structural engineer and the stress analyst.

27-182. **Proceedings Second Annual Spring Meeting, June 13, 1946.** 86 p., Metal Powder Association, New York, N. Y.

Papers include: "Use of Graphite in Iron Powder Compacts" by E. S. Glauch; "Furnace Atmospheres for Sintering" by H. M. Webber and A. G. Hotchkiss; "Sintered High Density Tungsten and Tungsten Alloy Parts" by Jack Kurtz; "Fundamental Facts About Iron Powder Costs" by B. T. DuPont; "Testing Methods in Use in Determining the Properties of Iron Powders" by J. E. Drapeau, Jr.; "Some Relationships Between Properties of Iron Powders and Properties of Parts Made From Them" by F. V. Lenel; and "Physical Properties of Parts Made From Iron Powders" by C. G. Goetzel.

27-183. **Proceedings of the Society for Experimental Stress Analysis, v. 4, no. 1.** 1946. 129 p., Addison-Wesley Press, Inc., Cambridge 42, Mass. $5.00.

Twelve papers on theoretical and experimental stress analysis.

27-184. **Qualitative Analysis by Spot Tests.** Fritz Feigl. 574 p., Elsevier Publishing Co., Inc., New York.

Present edition includes the newer spot reactions, to-

gether with details of the pertinent procedure and applications. Attempts to assemble and present the entire literature on spot test analysis in ready available form. Includes a chapter on detection of free elements and a bibliography on the applications of spot reactions.

27-185. **Use of Tools.** 1945. 258 p., United States Government Printing Office, Washington, D. C.

Illustrated Navy Training Course book gives instructions for the care and use of common tools . Begins with advice on the handling of such general purpose tools as hammers, screwdrivers, pliers, punches, and wrenches. It explains the use of the tools used for cutting and shaping metal—chisels, hacksaws, files, snips, drills and reamers. Chapters are devoted to threading tools, pipe and tubing tools, woodworking tools, measuring tools, gages and indicators, soldering and welding tools, special tools, metal fastening devices, and abrasives.

ADDRESSES OF PUBLICATIONS

Acoustical Society of America Journal, 57 E. 55th St., New York 22, N. Y.
Aero Digest, 515 Madison Ave., New York 22, N. Y.
Aeronautical Engineering Review, 20th and Northampton Streets, Easton, Pa.
Aircraft Engineering, 12 Bloomsbury Sq., London, W.C.1, England
Aircraft Production, Stamford St., London, S.E.1, England
Alloy Casting Bulletin, 39 Broadway, New York, N. Y.
Alloy Metals Review, Ditton Road, Widnes, Lancashire, England
Aluminum and Magnesium, 425 W. 25th St., New York 1, N. Y.
Aluminium and the Non-Ferrous Review, 25 High St., Merton, S.W.19, England
American Ceramic Society Bulletin, 2525 N. High St., Columbus 2, Ohio
American Ceramic Society Journal, 2525 N. High St., Columbus 2, Ohio
American Chemical Society Journal, 1155 16th St., N. W., Washington 6, D. C.
American Dyestuff Reporter, 1 Madison Ave., New York 10, N. Y.
American Electroplaters' Society Monthly Review (See Monthly Review)
American Foundryman, 222 West Adams St., Chicago 6, Ill.
American Foundrymen's Association Transactions, 222 West Adams St., Chicago 6, Ill.
American Gas Association Monthly, 420 Lexington Ave., New York 17, N. Y.
American Gas Journal, 53 Park Place, New York 7, N. Y.
American Institute of Chemical Engineers Transactions, 15 North 7th St., Philadelphia 6, Pa.
American Institute of Electrical Engineers Transactions, 33 W. 39th St., New York 18, N. Y. (See Electrical Engineering)
American Institute of Mining and Metallurgical Engineers Transactions, 29 W. 39th St., New York 18, N. Y. (See also Metals Technology, Mining Technology)
American Institute of Physics (See Reviews of Modern Physics)
American Iron and Steel Institute Yearbook, 350 Fifth Ave., New York 1, N. Y.
American Machinist, 330 W. 42nd St., New York 18, N. Y.
American Mineralogist, 450-454 Ahnaip St., Menasha, Wis.
American Paint Journal, 3713 Washington Ave., St. Louis 8, Mo.
American Petroleum Institute Quarterly, 50 W. 50th St., New York 20, N. Y.
American Pressman, Pressmen's Home, Tenn.

American Printer, 56th & Chestnut St., Philadelphia 39, Pa.
American Railway Engineering Association Bulletin, 59 E. Van Buren St., Chicago 5, Ill.
American Society for Metals Transactions, 7301 Euclid Ave., Cleveland 3, Ohio
American Society for Testing Materials Bulletin, 1916 Race St., Philadelphia 3, Pa.
American Society for Testing Materials Proceedings, 1916 Race St., Philadelphia 3, Pa.
American Society of Mechanical Engineers Journal, 29 W. 39th St., New York 18, N. Y. (See Mechanical Engineering)
American Society of Mechanical Engineers Transactions, 29 W. 39th St., New York 18, N. Y.
American Society of Naval Engineers Journal, Navy Bldg., Constitution Ave., 16th & 17th St., N.W., Washington, D. C.
American Society of Tool Engineers (See Tool Engineer)
American Water Works Association Journal, 500 Fifth Ave., New York 18, N. Y.
American Welding Society (See Welding Journal)
Analyst, Hills Road, Cambridge, England
Architectural Forum, 10 Ferry St., Concord, N. H.
Architectural Record, 34 N. Crystal St., E. Stroudsburg, Pa.
Army Ordnance, Suite 705, Mills Bldg., Washington 6, D. C.
Australasian Institute of Mining and Metallurgy Proceedings, 399 Little Collins St., Melbourne, Victoria, Australia
Automobile Engineer, Dorset House, Stamford St., London, S.E.1, England
Automotive and Aviation Industries, Chestnut and 56th St., Philadelphia 39, Pa.
Aviation, 330 W. 42nd St., New York 18, N. Y.

Bell Laboratories Record, 463 West St., New York 14, N. Y.
Bell System Technical Journal, 195 Broadway, New York, N. Y.
Better Enameling, 1427 South 55th Court, Cicero 50, Ill.
Blast Furnace and Steel Plant, 108 Smithfield St., Pittsburgh 30, Pa.
Brick & Clay Record, 59 E. Van Buren St., Chicago 5, Ill.
British Cast Iron Research Association Bulletin, Alvechurch, Birmingham, England
British Ceramic Society Transactions, The North Staffordshire Technical College, Stoke-on-Trent, England
British Non-Ferrous Metals Research Association Bulletin, Euston St., London, N.W.1, England
British Plastics, Dorset House, Stamford Street, London, S.E.1, England
British Steelmaker, Rodney House, Monmouth St., London, W.C.2, England
Brown Boveri Review, Baden, Switzerland
Business Week, 330 West 42nd St., New York 18, N. Y.

Canadian Chemistry and Process Industries, 137 Wellington St., West, Toronto 1, Ontario, Canada
Canadian Metals & Metallurgical Industries, 137 Wellington St., West, Toronto 1, Ontario, Canada
Canadian Mining and Metallurgical Bulletin, 906 Drummond Bldg., Montreal, Quebec, Canada
Ceramic Age, 421 Parker Street, Newark 4, N. J.
Ceramic Industry, 59 E. Van Buren St., Chicago 5, Ill.
Chemical Age, 154 Fleet St., London, E.C.4, England

ADDRESSES OF PUBLICATIONS

Chemical and Engineering News, 1155 16th St., N. W., Washington, D. C.
Chemical Engineering (Formerly Chemical & Metallurgical Engineering), 330 W. 42nd St., New York 18, N. Y.
Chemical Industries, 522 Fifth Ave., New York 19, N. Y.
Chemical, Metallurgical and Mining Society of South Africa, P. O. Box 4256, Johannesburg, South Africa
Chemical Reviews, Baltimore 2, Md.
Chemist Analyst, Phillipsburg, N. J.
Civil Engineering, 33 W. 39th St., New York, N. Y.
Coal Age, 330 W. 42nd St., New York 18, N. Y.
Coal Heat, 20 W. Jackson Blvd., Chicago, Ill.
Coke and Smokeless-Fuel Age, 33 Tothill St., Westminster, London, S.W.1, England
Colliery Guardian, 30 & 31 Furnival Street, Holburn, London, E.C.4, England
Combustion, 200 Madison Ave., New York 16, N. Y.
Compressed Air Magazine, Phillipsburg, N. J.
Corrosion, 905 Southern Standard Bldg., Houston 2, Texas
Corrosion and Material Protection, 1131 Wolfendale Street, Pittsburgh, Pa.
Crown, Box 1837, Baltimore 3, Md.

Deco Trefoil, P. O. Box 5268, Denver 17, Colo.
Department of State Bulletin, Washington 25, D. C.
Die Casting, 1240 Ontario St., Cleveland, Ohio
Domestic Commerce, Superintendent of Documents, Government Printing Office, Washington 25, D. C.
Drop Forging Topics, 605 Hanna Bldg., Cleveland 15, Ohio

Edgar Allen News, Edgar Allen & Co., Ltd., Sheffield 9, England
Electric Light and Power, 360 North Michigan Ave., Chicago, Ill.
Electrical Engineering, 33 West 39th St., New York 18, N. Y.
Electrical Manufacturing, 1250 Avenue of the Americas, New York 20, N. Y.
Electrochemical Society Transactions, 3000 Broadway, New York 27, N. Y.
Electrodepositors' Technical Society Journal, St. John St., Clerkenwell, London, E.C.1, England
Electronic Engineering, 43 Shoe Lane, London, E.C.4, England
Electronic Industries, 480 Lexington Ave., New York 17, N. Y.
Electronics, 330 W. 42nd St., New York 18, N. Y.
Electrotypers & Stereotypers Journal, 329 High Holborn, London, W.C.1, England
Enamelist, 4150 East 56th St., Cleveland 5, Ohio
Engineer, 28 Essex St., Strand, London, W.C.2, England
Engineering, 35-36 Bedford St., Strand, London, W.C.2, England
Engineering and Mining Journal, 330 W. 42nd St., New York 18, N. Y.
Engineering News-Record, 330 W. 42nd St., New York 18, N. Y.
Engineers' Digest (American Edition), 1 Madison Ave., New York 10, N. Y.

Factory Management and Maintenance, 330 W. 42nd St., New York 18, N. Y.
Faraday Society Transactions, 98 Great Russell St., London, England
Fasteners, 1550 Hanna Bldg., Cleveland 15, Ohio
Finish, 360 N. Michigan Ave., Chicago 1, Ill.

Flow, 812 Huron Bldg., Cleveland 15, Ohio
Food Industries, 330 W. 42nd St., New York 18, N. Y.
Foote Prints, 500 Germantown Trust Co. Bldg., Philadelphia, Pa.
Fortune, 330 E. 22nd St., Chicago 16, Ill.
Foundry, Penton Bldg., Cleveland, Ohio
Foundry Trade Journal, 49 Wellington St., Strand, London, W.C.2, England
Franklin Institute Journal, Parkway at 20th St., Philadelphia, Pa.
Fuel in Science and Practice, 3 Thorny Court, Palace Gate, London, England
Fueloil & Oil Heat, 232 Madison Ave., New York 16, N. Y.
Fusion Point, 81 Madison Bldg., Memphis, Tenn.

Gas Age, 56th & Chestnut St., Philadelphia 39, Pa.
Gas Journal, 11 Bolt Court, Fleet St., London, E.C.4, England
Gas Times, 29 Grove Road, Leighton Buzzard, Beds., England
General Electric Review, Schenectady 5, N. Y.
Glass Industry, 55 W. 42nd St., New York 18, N. Y.
Graphic Arts Monthly, 608 South Dearborn St., Chicago 5, Ill.
Gray Iron Progress, Battelle Memorial Institute, Columbus 1, Ohio

Heating and Ventilating, 148 Lafayette St., New York 13, N. Y.
Heating Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

India Rubber World, 386 Fourth Ave., New York 16, N. Y.
Industrial and Engineering Chemistry, 1155 16th St., N. W., Washington 6, D. C.
Industrial Chemist, 33 Tothill St., Westminster, London, S.W.1, England
Industrial Diamond Review, 37 South Wabash Ave., Chicago, Ill.
Industrial Finishing, 1142 N. Meridian St., Indianapolis 4, Ind.
Industrial Gas, 56th & Chestnut St., Philadelphia 39, Pa.
Industrial Heating, Union Trust Bldg., Pittsburgh, Pa.
Industrial Marketing, 100 East Ohio St., Chicago, Ill.
Industrial Radiography, 53 W. Jackson Blvd., Chicago, Ill.
Industry and Power, St. Joseph, Mich.
Industry and Welding, 1240 Ontario St., Cleveland 13, Ohio
Inland Printer, 309 W. Jackson Blvd., Chicago, Ill.
Institute of Metals Journal, 4 Grosvenor Gardens, London, S.W.1, England
Institute of Radio Engineers Proceedings, 330 W. 42nd St., New York 18, N. Y.
Institute Spokesman, 498 Winspear Ave., Buffalo 15, N. Y.
Institute of Welding Transactions, 2 Buckingham Palace Gardens, London, S.W.1, England
Institution of Automobile Engineers, 12 Hobart Place, London, S.W.1, England
Institution of Mechanical Engineers, Storey's Gate, St. James Park, London, S.W.1, England
Instrument Maker, 1117 Wolfendale St., Pittsburgh 12, Pa.
Instrumentation, Wayne and Roberts Aves., Philadelphia 44, Pa.
Instruments, 1117 Wolfendale St., Pittsburgh 12, Pa.
Insulation, 45 W. 45th St., New York 19, N. Y.
Interchemical Review, 432 W. 45th St., New York, N. Y.
Iron Age, 100 E. 42nd St., New York 17, N. Y.
Iron and Steel, Dorset House, Stamford St., London, S.E.1, England

Iron and Steel Engineer, Empire Bldg., Pittsburgh, Pa.
Iron and Steel Institute Bulletin and Journal, 4 Grosvenor Gardens, London, S.W.1, England

Journal of Agricultural Research, Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
Journal of Applied Mechanics, 29 W. 39th St., New York 18, N. Y.
Journal of Applied Physics, 57 E. 55th St., New York 22, N. Y.
Journal of Chemical Education, 20th & Northampton Sts., Easton, Pa.
Journal of Chemical Physics, 57 E. 55th St., New York 22, N. Y.
Journal of Organic Chemistry, Mount Royal & Guilford Ave., Baltimore 2, Md.
Journal of Physical Chemistry, Mount Royal & Guilford Ave., Baltimore 2, Md.
Journal of Physics, Academy of Sciences of U.S.S.R., Moscow, U.S.S.R.
Journal of Research, National Bureau of Standards, Government Printing Office, Washington, D. C.
Journal of Scientific Instruments, The Institute of Physics, 19 Albemarle St., London, W.1, England
Journal of the Aeronautical Sciences, 2 E. 64th St., New York 21, N. Y.

Lead, 420 Lexington Ave., New York 17, N. Y.
Light Metal Age, 201 North Wells St., Chicago 6, Ill.
Light Metals, Bowling Green Lane, 5-17 Roseberry Ave., London, E.C.1, England
Light Metals Review, Salisbury House, Londonwall, E.C.2, England
Linde Tips (Formerly Oxy-Acetylene Tips), 30 E. 42nd St., New York 17, N. Y.
Lubrication, 135 E. 42nd Street, New York City

Machine Design, Penton Bldg., Cleveland, Ohio
Machine Tool Blue Book, 542 S. Dearborn St., Chicago 5, Ill.
Machinery (London), National House, West Street, Brighton 1, England
Machinery (N. Y.), 148 Lafayette St., New York 13, N. Y.
Magnesium Review and Abstracts, Magnesium Elektron Ltd., Abbey House, London, N.W.1, England
Mainspring, Associated Spring Corp., Bristol, Conn.
Materials & Methods, 330 W. 42nd St., New York 18, N. Y.
Mechanical Engineering, 29 W. 39th St., New York 18, N. Y.
Mechanization, Munsey Bldg., Washington 4, D. C.
Metal Finishing, 11 W. 42nd St., New York 18, N. Y.
Metal Industry, Dorset House, Stamford St., London, S.E.1, England
Metal Progress, 7301 Euclid Ave., Cleveland 3, Ohio
Metal Treatment, 49 Wellington St., Strand, London, W.C.2, England
Metallurgia, 31 King St., West, Manchester 3, England
Metals, 425 W. 25th St., New York 1, N. Y.
Metals and Alloys, 330 W. 42nd St., New York 18, N. Y.
Metals Technology, 29 W. 39th Street, New York 18, N. Y.
Mine & Quarry Engineering, 23 Great Queen St., London, W.C.2, England
Mines Magazine, 734 Cooper Bldg., Denver 2, Colo.
Mining and Metallurgy, 29 W. 39th St., New York 18, N. Y.

Mining Congress Journal, 309 Munsey Bldg., Washington 4, D. C.
Mining Journal, 520-528 Title & Trust Bldg., Phoenix, Ariz.
Mining Technology, 29 W. 39th Street, New York 18, N. Y.
Mining World, 121 7th St., San Francisco 5, Calif.
Modern Industrial Press, Windsor Manor, P. O. Box 687, Pittsburgh 30, Pa.
Modern Industry, 347 Madison Ave., New York 17, N. Y.
Modern Lithography, 254 W. 31st St., New York 1, N. Y.
Modern Machine Shop, 431 Main St., Cincinnati 2, Ohio
Modern Metals, Burnham Bldg., Chicago 1, Ill.
Modern Plastics, 122 E. 42nd St., New York 17, N. Y.
Monthly Review, 5800 N. Mervine St., Philadelphia, Pa.

National Bureau of Standards (See Journal of Research)
National Petroleum News, 1213 W. 3rd St., Cleveland 13, Ohio
Natural Gases, 1217 Hudson Blvd., Bayonne, N. J.
Nature, St. Martin's St., London, W.C.2, England
Nickel Bulletin, Grosvenor House, Park Lane, London, England

Ohio State University, Engineering Experiment Station News, Columbus, Ohio
Oil and Gas Journal, 211 S. Cheyenne Ave., Tulsa 1, Okla.
Oil & Soap, 35 E. Wacker Dr., Chicago 1, Ill.
Optical Society of America Journal, American Institute of Physics, 57 E. 55th St., New York 22, N. Y.
Organic Finishing, 11 W. 42nd St., New York 18, N. Y.
Oxy-Acetylene Tips, 30 E. 42nd St., New York 17, N. Y.

Pacific Plastics, 124 W. 4th St., Los Angeles 13, Calif.
Paint Manufacture, Leonard Hill Ltd., 17 Stratford Place, London, England
Paint and Varnish Production Manager, Mills Bldg., Washington 6, D. C.
Paint, Oil & Chemical Review, 537 S. Dearborn St., Chicago 5, Ill.
Paint Technology, 5 Grange Court, Pinner, Middlesex, England
Paper Industry and Paper World, 59 E. Van Buren St., Chicago 5, Ill.
Paper Mill News, 1309 Noble St., Philadelphia 23, Pa.
Paper Trade Journal, 15 W. 47th St., New York 19, N. Y.
Petroleum Engineer, Irwin-Kaesler Bldg., Dallas 1, Texas
Petroleum Refiner, Gulf Publishing Co., 3301 Buffalo Dr., Houston, Texas
Phillips Technical Review, 215 4th Ave., New York, N. Y.
Photo-Engravers Bulletin, 166 W. Van Buren St., Chicago 4, Ill.
Physical Review, 57 E. 55th St., New York 22, N. Y.
Physical Society Proceedings, 1 Lowther Gardens, Exhibition Rd., London, S.W.7, England
Pit and Quarry, 538 S. Clark St., Chicago 5, Ill.
Plastics (American), 185 N. Wabash Ave., Chicago 1, Ill.
Plastics, Bowling Green Lane, London, E.C.1, England
Powder Metallurgy Bulletin, American Electro Metal Corp., 320 Yonkers Ave., Yonkers 2, N. Y.
Printing Equipment Engineer, 1276 W. 3rd St., Cleveland 13, Ohio
Product Engineering, McGraw-Hill Publishing Co., 330 W. 42nd St., New York 18, N. Y.
Production & Engineering Bulletin, St. James Square, London, S.W.1, England

Production Engineering & Management, 2842 West Grand Blvd., Detroit 2, Mich.
Products Finishing, 431 Main St., Cincinnati 2, Ohio
Publishers' Weekly, 62 West 45th St., New York 19, N. Y.

Railway Age, 30 Church St., New York 7, N. Y.
Railway Engineering and Maintenance, 105 W. Adams St., Chicago 3, Ill.
Railway Mechanical Engineer, 30 Church St., New York 7, N. Y.
Refractories Journal, Rodney House, 6 Monmouth St., London, W.C.2, England
Review of Scientific Instruments, 57 E. 55th St., New York 22, N. Y.
Reviews of Modern Physics, American Institute of Physics, 57 E. 55th St., New York 22, N. Y.
Royal Society Proceedings, Bentley House, N.W.1, London, England
Rubber Age, 250 W. 57th St., New York 19, N. Y.
Russian Technical Research News, American Russian Institute, 58 Park Ave., New York 16, N. Y.

Science, Lancaster, Pa.
Scientific American, 24 W. 40th St., New York 18, N. Y.
Screw Machine Engineering, 45 Exchange St., Rochester 4, N. Y.
Sheet Metal Industries, 49 Wellington St., London, W.C.2, England
Sheet Metal Worker, 1309 Noble St., Philadelphia 23, Pa.
Skilling's Mining Review, 501 Builders Exchange, Duluth 2, Minn.
Society of Automotive Engineers Journal, 29 W. 39th St., New York 18, N. Y.
Society of Chemical Industry (Journal and Transactions), 56 Victoria St., London, S.W.1, England
Society of Glass Technology Journal, Northumberland Rd., Sheffield 10, England
Society of Motion Picture Engineers, Hotel Pennsylvania, New York 1, N. Y.
Solid Fuel Engineer, Box 12, Columbia, Mo.
Steel, Penton Bldg., Cleveland 13, Ohio
Steel Processing, 108 Smithfield St., Pittsburgh 30, Pa.
Stove Builder, Shoreham Hotel, Washington 8, D. C.

Tin and Its Uses, Fraser Rd., Greenford, Middlesex, England
Tool & Die Journal, 2460 Fairmount Blvd., Cleveland 6, Ohio
Tool Engineer, 1666 Penobscot Bldg., Detroit 26, Mich.

United Effort, First National Bank Bldg., Pittsburgh, Pa.

Vancoram Review, 420 Lexington Ave., New York 17, N. Y.

Water & Sewage Works (Formerly Water Works & Sewerage), 22 W. Maple St., Chicago, Ill.
Welder, Waltham Cross, Herts., England
Welding, Dorset House, Stamford St., London, S.E.1, England
Welding Engineer, 330 W. 42nd St., New York, N. Y.
Welding Journal, 33 W. 39th St., New York 18, N. Y.
West Scotland Iron & Steel Institute Journal, 93 Hope St., Glasgow, Scotland
Western Machinery and Steel World, 500 Sansome St., San Francisco, Calif.

Western Metals, 1709 W. 8th St., Los Angeles 14, Calif.
Western Miner, 505 Metropolitan Bldg., Vancouver, B. C.
Westinghouse Engineer, 306 4th Ave., P. O. Box 1017, Pittsburgh 30, Pa.
Wire and Wire Products, 300 Main St., Stamford, Conn.
Wire Industry, 33 Furnival St., London, E.C.4, England

Foreign Language Journals

Academy of Sciences of U.S.S.R. Bulletin (Section of Technical Science), Academy of Sciences of U.S.S.R., Moscow, U.S.S.R.
Archiv fur Eisenhuttenwesen, Breite Str. 27, Dusseldorf, Germany

Comptes Rendus, Quai des Grands-Augustins 55, Paris, France

Fonderie, 46 Ave. Victor-Hugo, Paris 16, France

Helvetica Chimica Acta, Basil, Switzerland

Korrosion und Metallschutz, Berlin, Germany

Luftfahrtforschung, Gluckstr. 8, Munich 32, Germany

Jernkontorets Annaler, Kungstradgardsgatan 6, Stockholm C, Sweden
Journal of Applied Chemistry, Academy of Sciences of U.S.S.R., Moscow, U.S.S.R.
Journal of Experimental and Theoretical Physics, Academy of Sciences of U.S.S.R., Moscow, U.S.S.R.

Metalen, 1-3 Scheepmakerstraat, 'S-Gravenhage, Netherlands
Metaux-Corrosion-Usure, 14 Rue de Tournon, Paris, France
Metaux et Corrosion, 32 Rue du Marechal-Joffre, St. Germain-en-Laye, France

Reports of the Academy of Science, Academy of Sciences of U.S.S.R., Moscow, U.S.S.R.
Revue de Metallurgie (Memoirs et Extraits), 5 Cite Pigalle, Paris, France

Schweizer Archiv, Solothurn, Switzerland
Stahl und Eisen, Dusseldorf, Germany

Zeitschrift fur Metallkunde, VD1 Verlag, Berlin, N.W.7, Germany

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SUBJECT INDEX

By Meredith Smith Wright

The 27 classifications of the Review of Metal Literature are primarily classifications by *process*, and therefore in preparing this index, the major emphasis has been placed on *materials*. It is hoped that sufficient cross-references have been included to guide the user who is seeking *all* material on a subject which is not a sectional division. Under subject headings which are also sectional headings (such as **Corrosion, Welding, Electroplating**) only a general reference has been made to other entries, on the assumption that a user desiring all material would turn first to the appropriate section in the book rather than to the subject index.

Alloy systems are indexed in the order of the constituent whose initial letter comes first in the alphabet, i.e., **Aluminum-gold, Copper-nickel, Tin-zinc,** with no regard to percentage composition. Indexing is by section number and item number rather than by page. The bold face numerals preceding the hyphen refer to the section number; the light face numerals following the hyphen refer to the number of the literature listing.—M.S.W.

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